



Control Unit

CU240S
CU240S DP
CU240S DP-F

Software version 2.0



SINAMICS

G120

SIEMENS

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SINAMICS G120 Control Units CU240S

Operating Instructions (Compact)

Installing/Mounting

1

Commissioning (software)

2

Operation

3

Service and maintenance

4

Troubleshooting/FAQs

5

Note

This Compact Operating Instructions contains the most important information for commissioning and operation of the inverter.

The Compact Operating Instructions can be used for Quick Commissioning of standard applications.

Additional information can be found in the full Operating Instructions and in the Parameter list. These manuals are available in English and German.

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Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.



Danger

indicates that death or severe personal injury **will** result if proper precautions are not taken.



Warning

indicates that death or severe personal injury **may** result if proper precautions are not taken.



Caution

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

Caution

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

Notice

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:



Warning

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Table of contents

1	Installing/Mounting.....	1-1
1.1	Fitting the CU to the PM.....	1-2
1.2	Connecting the Control Unit via terminals	1-3
1.2.1	Common information to the control terminals.....	1-3
1.2.2	Setting-up the Control Unit via terminals	1-4
1.2.3	Control wiring for a CU240S Control Unit with default setting	1-5
1.2.4	Voltage input control wiring.....	1-7
1.2.5	Current input control wiring	1-8
1.3	Installing the Encoder Interface	1-10
2	Commissioning (software)	2-1
2.1	General commissioning information	2-1
2.2	Parameters.....	2-2
2.2.1	Overview of Parameters	2-2
2.2.2	Write parameters	2-3
2.2.3	Monitoring parameters	2-3
2.2.4	Parameter Attributes	2-3
2.3	Factory settings.....	2-9
2.4	Parameterization with Operator Panel.....	2-11
2.4.1	Handling of the Operator Panel	2-11
2.4.2	Function Keys of the OP	2-12
2.4.3	Changing parameters via OP.....	2-13
2.5	Parameterization with MMC.....	2-14
2.6	Parameterization with STARTER.....	2-14
2.6.1	Commissioning with STARTER	2-14
2.7	Commissioning modes.....	2-16
2.7.1	Commissioning overview	2-16
2.7.2	Quick commissioning	2-18
2.7.3	Quick Commissioning - flow chart.....	2-19
2.7.4	Calculating the motor and control data	2-24
2.7.5	Calculating the motor and control data - flow chart	2-25
2.7.6	Motor data identification.....	2-26
2.7.7	Motor data identification - flowchart	2-29
2.7.8	Commissioning the application	2-30
2.7.8.1	Commissioning the application	2-30
2.7.8.2	Flow chart - General settings.....	2-31
2.7.8.3	Flow chart - Pulse encoder	2-31
2.7.8.4	Flow chart - Temperature Sensor	2-32
2.7.8.5	Flow chart - Command source.....	2-32
2.7.8.6	Flow chart - Digital output functions.....	2-34
2.7.8.7	Flow chart - Frequency setpoint.....	2-34
2.7.8.8	Flow chart - Analog outputs	2-37
2.7.8.9	Flow chart - JOG frequency	2-38

2.7.8.10	Flow chart - Additional Setpoints	2-38
2.7.8.11	Flow chart - Skip Frequency	2-39
2.7.8.12	Flow chart - Ramp times, rounding	2-39
2.7.8.13	Flow chart - Finishing the application setting	2-40
2.7.9	Series Commissioning	2-41
2.7.9.1	Series commissioning	2-41
2.7.9.2	Series commissioning with the OP	2-43
2.7.9.3	Series commissioning with STARTER	2-45
2.7.9.4	Inserting and removing the MMC	2-46
2.7.9.5	Series commissioning with MMC	2-47
2.7.10	Reset parameters to factory settings	2-52
2.7.11	Reset parameters to factory settings - Flow chart	2-53
2.8	Encoder Commissioning	2-54
2.8.1	Commissioning the Encoder Interface	2-54
2.8.2	Parameterizing the Encoder Interface	2-56
2.8.3	Encoder fault codes	2-59
3	Operation	3-1
3.1	General Operation behaviour	3-1
3.2	Start-up Behavior	3-1
3.2.1	Normal Start-up behavior of the Inverter	3-2
3.2.2	Swap Behavior of the Inverter	3-5
3.3	Upload and download of parameter sets	3-9
4	Service and maintenance	4-1
4.1	Service and support information	4-1
4.2	Faults and Alarms	4-3
4.3	LED Overview	4-4
4.4	Normal Status LEDs	4-6
4.5	Fail-Safe Function Status LEDs	4-7
4.6	Further indication for LEDs	4-8
4.7	Troubleshooting with the OP	4-9
5	Troubleshooting/FAQs	5-1
	Index	Index-1

Tables

Table 1-1	Encoder interface terminals	1-10
Table 1-2	Typical Encoder connections	1-11
Table 1-3	Encoder voltage settings.....	1-11
Table 2-1	Parameter attributes - BICO	2-4
Table 2-2	Parameter attributes - access level	2-5
Table 2-3	Parameter attributes - Change state.....	2-5
Table 2-4	Parameter attributes - Data types	2-6
Table 2-5	Parameter attributes - Unit.....	2-6
Table 2-6	Parameter attributes - Grouping	2-7
Table 2-7	Parameter attributes - Active	2-7
Table 2-8	Parameter attributes - Quick commissioning	2-8
Table 2-9	Parameter attributes - Value range.....	2-8
Table 2-10	Data sets	2-8
Table 2-11	Pre-assignment of the digital inputs for a CU240S *)	2-10
Table 2-12	OP keys and their functions	2-12
Table 2-13	Changing P0003 - parameter access level	2-13
Table 2-14	Changing P0719 an index parameter - setting OP control	2-13
Table 2-15	Connection possibilities for STARTER	2-14
Table 2-16	Quick commissioning - flow chart	2-20
Table 2-17	Automatic download fault codes	2-51
Table 2-18	Commissioning the Encoder	2-55
Table 2-19	Encoder voltage settings.....	2-56
Table 2-20	Encoder parameters	2-56
Table 3-1	Automatic download fault codes	3-4
Table 3-2	Automatic download fault codes	3-8
Table 4-1	Status display.....	4-6
Table 5-1	Alarm numbers, cause and remedy	5-3
Table 5-2	Identification of communications firmware	5-4
Table 5-3	Standard diagnostics	5-4
Table 5-4	Parameter accessing error numbers	5-5

Installing/Mounting

Installing the Control Unit

The Control Unit allows the user to access the full functionality of the inverter.



Warning

An inverter can be switched on unintentionally if the installation is not performed correctly. The inverter must be started-up by personnel who are qualified and trained in installing systems of this type.

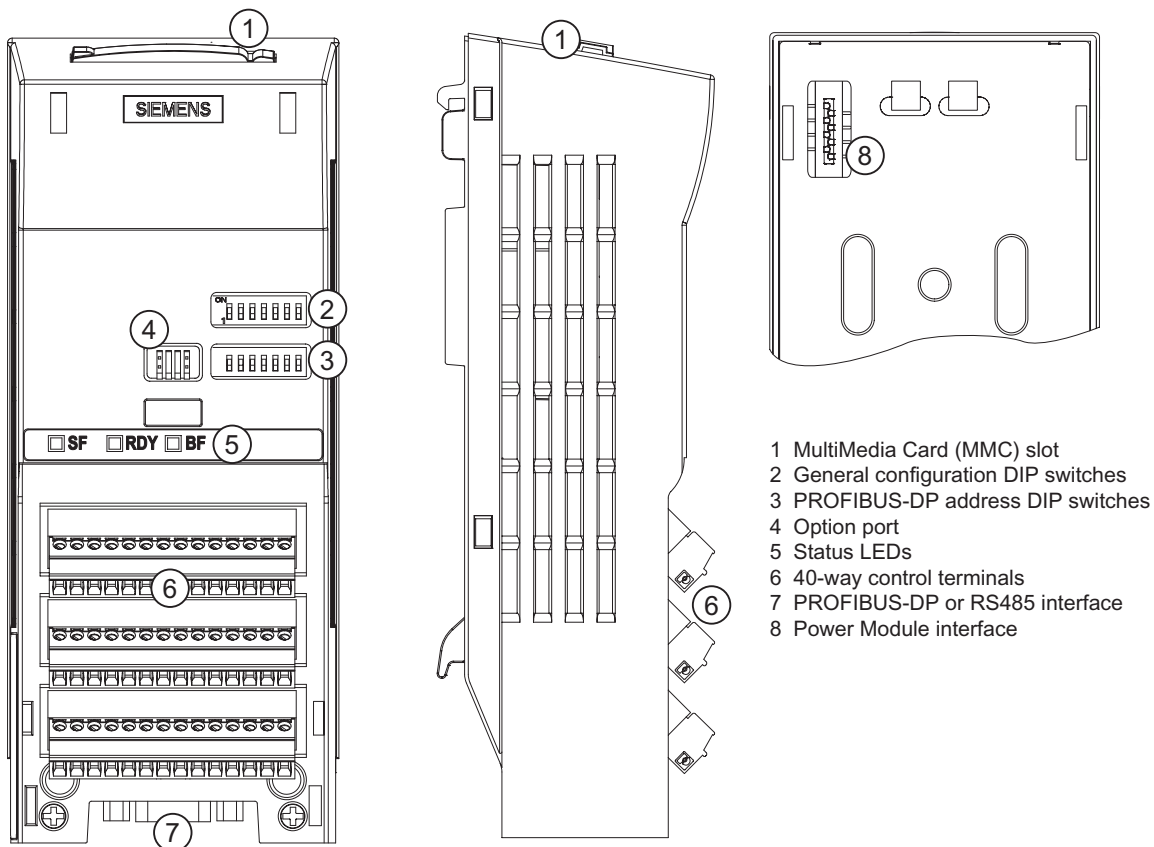


Figure 1-1 General layout of a CU240 Control Unit

1.1 Fitting the CU to the PM

Fitting the Control Unit to the Power Module

The Control Unit is fitted to the Power Module as shown in the figure below. To disconnect the CU push the release button on top of the PM.

The process of fitting the Control Unit to the Power Module is the same technique no matter which Control Unit or Power Module combination is required.

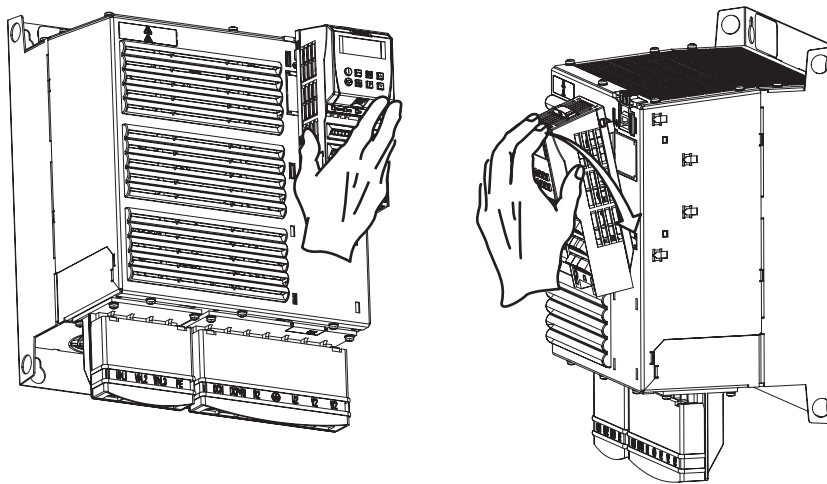


Figure 1-2 Fitting the Control Unit to the Power Module



Caution

Before snap-on the Control Unit to the Power Module while hot swap connect 24 V supply to the terminals.

1.2 Connecting the Control Unit via terminals

1.2.1 Common information to the control terminals

Common information to the control terminals

To have access to the control terminals, the terminal cover must be removed, as shown in the figure below. The control terminals have a maximum tightening torque of 0.25 Nm (2.2 lbf.in) and a nominal cable cross section of 1.5 mm².

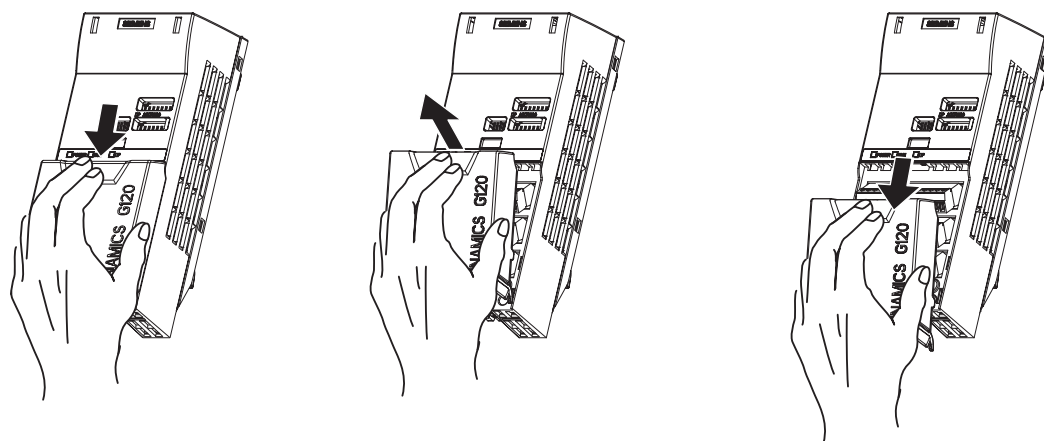


Figure 1-3 Removing the Control Unit terminal cover

The terminals of all variants of CU240 control units, once they have been wired, can be individually detached from the control terminal board housing, as shown in the figure below. This allows the control units to be swapped out for another of the same type without the need for rewiring.

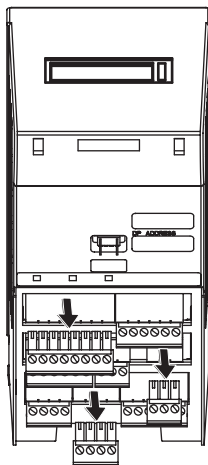


Figure 1-4 Removing the two-part connectors with a CU240S DP as example

After all the wiring of the control unit is completed - ensure that the terminal cover is replaced.

1.2.2 Setting-up the Control Unit via terminals

Terminal wiring examples for the Control Unit CU240S, not for CU240S DP and CU240S DP-F

In this section examples of controlling a SINAMICS G120 inverter with a CU240S via terminals are shown.

- Basic control with the default settings
- Frequency setpoint and an additional setpoint via terminals (AI0 and AI1 used as voltage inputs)
- Frequency setpoint and an additional setpoint via terminals (AI0 and AI1 used as current inputs).

Note

To control the CU240S DP or CU240S DP-F via terminals is also possible, but in this case the parameter settings for command and setpoint source have to be changed.

1.2.3 Control wiring for a CU240S Control Unit with default setting

Basic control with the default settings

When shipped from the factory and fitted to the power module, a factory reset must be performed to read the power stack data into the control unit, before operating the inverter with the basic settings.

To operate the inverter with the basic settings, (without additional parameterization or DIP switch setting) the following conditions have to be fulfilled:

- The rated current of the inverter is at least as great as the rated current of the motor.
- The power range of the inverter matches the power range of the motor.
- The controlled motor is a 4-pole motor (best Siemens 1LA7).
- The default motor frequency for the inverter is 50 Hz and the units of measure is kW.

Control settings

- **Run and Stop Command**
The run and stop commands can be given using digital input 0 on terminal 5.
- **Frequency Setpoint**
The required frequency can be achieved connecting a potentiometer to the analog inputs on terminals 3 and 4.
- **Reverse**
A change of direction can be accomplished using digital input 1 on terminal 6.
- **Fault Acknowledge (Ack)**
A fault on the inverter can be acknowledged using digital input 2 on terminal 7. This allows the fault signal to be reset.
- **Output Frequency**
The actual output frequency can be displayed using the analog outputs on terminals 12 and 13.
- **Fault**
Using relay 1 (RL1) on terminals 19 and 20 a fault condition can be indicated. For example using a lamp which will light-up to indicate a fault condition has occurred.
- **Warning**
Using relay 2 (RL2) on terminals 21 and 22 a warning condition can be indicated. For example using a lamp which will light-up to indicate a warning condition has occurred.

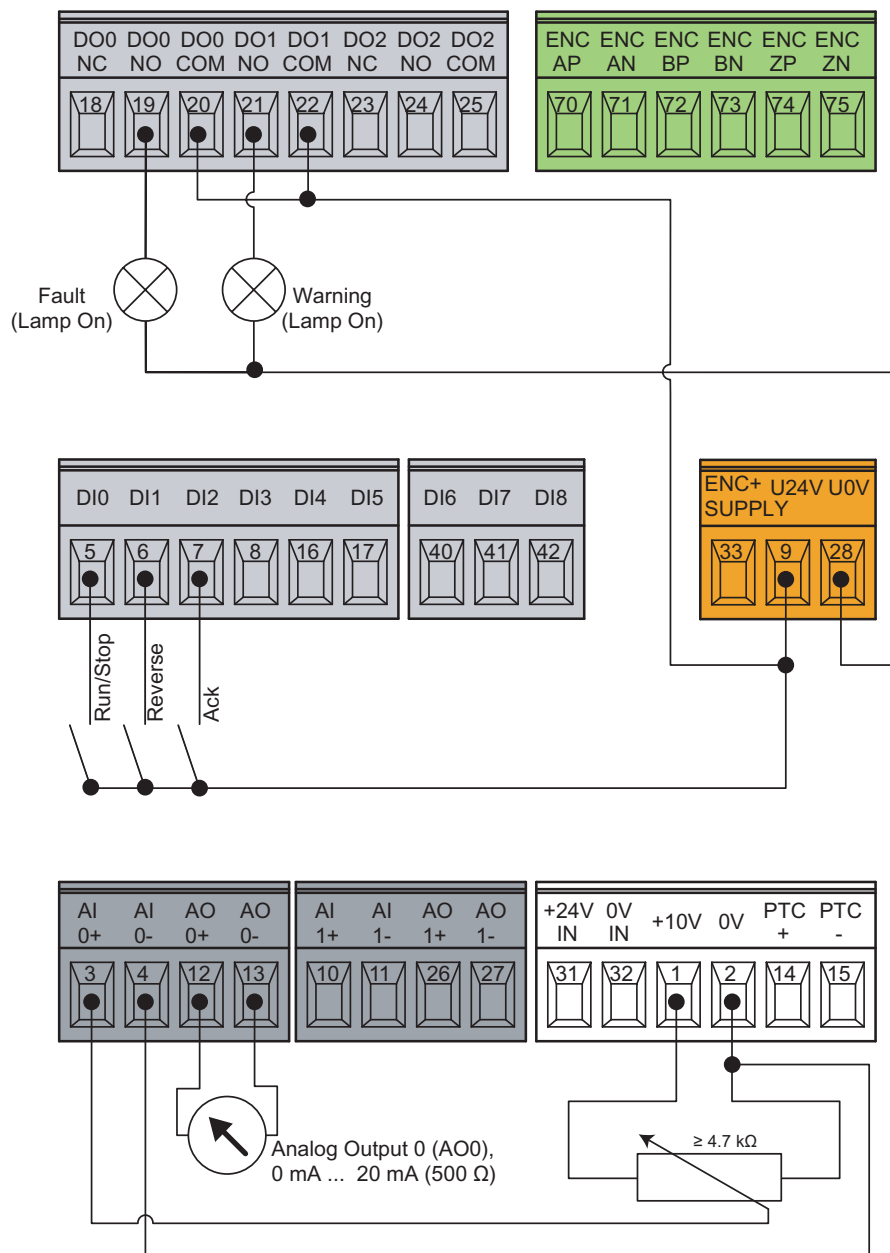


Figure 1-5 Default control wiring

1.2.4 Voltage input control wiring

Frequency setpoint and an additional setpoint via terminals

AI0 and AI1 used as voltage inputs

This type of control wiring allows a main frequency setpoint and an additional setpoint to be established, using potentiometers on analog inputs AI0 and AI1.

The figure below shows the wiring that is necessary to accomplish this functionality.

DIP switch Settings

The general I/O DIP switch is used to configure the analog inputs (AI). Use DIP switches 1 and 2 to set the switches to the OFF position. For detailed information refer to "Analog input" in section "Function".

Parameter Settings

No additional parameters require to be modified.

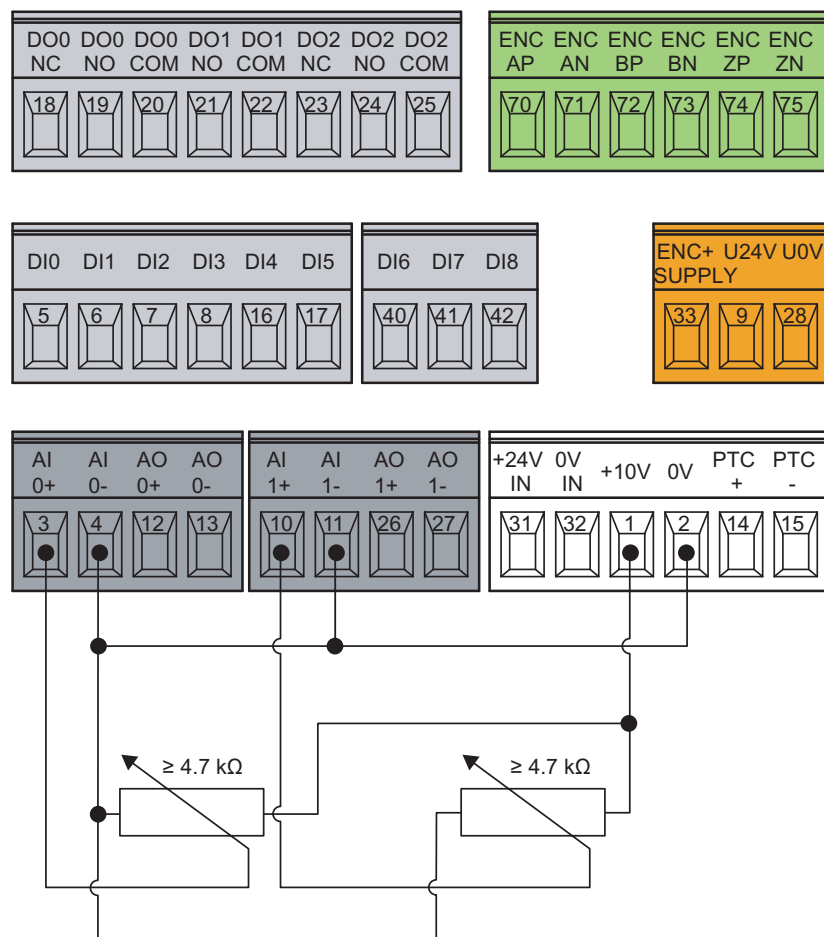


Figure 1-6 Terminal connection and DIP switch setting for using AI0 and AI1 as main and additional setpoint

1.2.5 Current input control wiring

Frequency setpoint and an additional setpoint via terminals

AI0 and AI1 used as current inputs

This type of control wiring allows a main frequency setpoint and an additional setpoint to be established, for example from a PLC.

The figure below shows the wiring that is necessary to accomplish this functionality.

DIP switch Settings

The general I/O DIP switch is used to configure the analog inputs (AI). Use DIP switches 1 and 2 to set the switches to the ON position. For detailed information refer to "Analog input" in section "Function".

Parameter Settings

The following parameter need to be changed to the values given below. These changes must only be made after the Quick Commissioning procedure has been completed.

To use 0 mA ... 20 mA

- P0003 = 3 Sets the access level to Expert.
- P1000[0] = 22 Setpoint now expected from the analog inputs.
- P0756[0] = 2 Sets analog input 0 (AI0) to current input.
- P0756[1] = 2 Sets analog input 1 (AI1) to current input.

To use 4 mA ... 20 mA

The following additional parameters need to be modified:

- P0757[0] = 4 Sets analog input 0 (AI0) to a minimum of 4 mA.
- P0761[0] = 4 Sets the deadband width of analog input 0 (AI0).
- P0757[1] = 4 Sets analog input 1 (AI1) to a minimum of 4 mA.
- P0761[1] = 4 Sets the deadband width of analog input 1 (AI1).

Note

Index [0] is analog input 0, Index [1] is analog input 1, if you are only using one analog input then you only need to change those indices for the specific analog input.

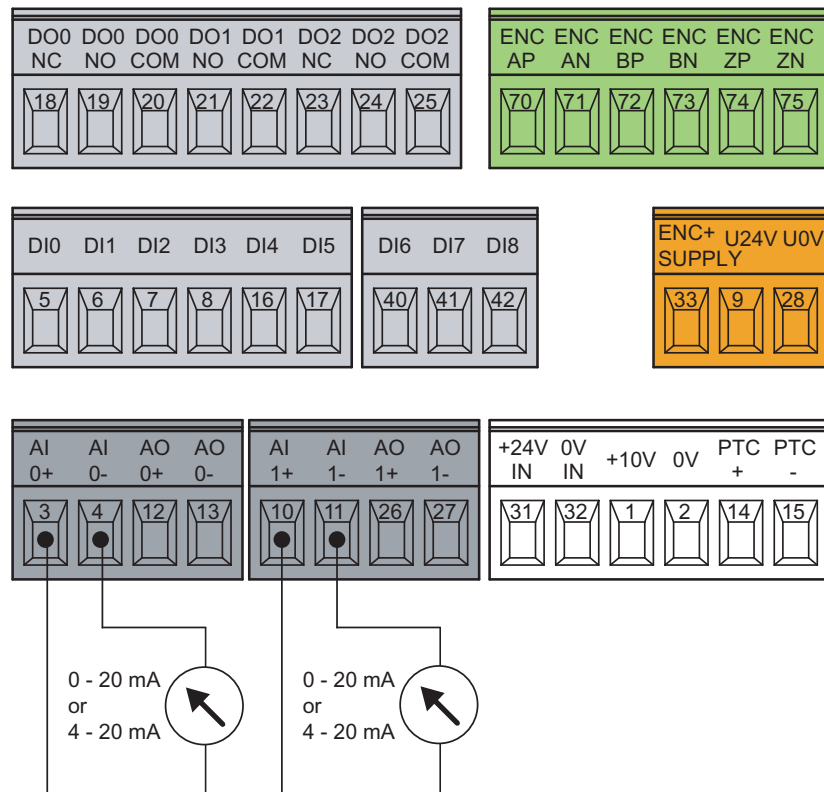


Figure 1-7 Current input control wiring

1.3 Installing the Encoder Interface

Preparation

- The Encoder unit has been fitted to the motor as described by the Installation Instructions supplied with the Encoder unit.
- The SINAMICS G120 inverter has been powered-down.

Screening

To ensure the correct functioning of the encoder the guidelines listed below should be followed:

- Only twisted-pair screened cable should be used to connect the encoder to the Encoder Interface.
- If the encoder cable has a screen/earth/ground conductor, this should be terminated to the backplane of the inverter or the cabinet housing.
- Signals cables must not be installed close to power cables.

Connections

The terminal descriptions and functions are shown in the table below.

Table 1-1 Encoder interface terminals

Terminal		Function
70	ENC AP	Channel A non-inverting input
71	ENC AN	Channel A inverting input
72	ENC BP	Channel B non-inverting input
73	ENC BN	Channel B inverting input
74	ENC ZP	Channel 0 (zero) non-inverting input
75	ENC ZN	Channel 0 (zero) inverting input
33	ENC+ Supply	5 V or 24 V power supply for encoder, configured by DIP switch
28	U0V	Isolated encoder supply reference

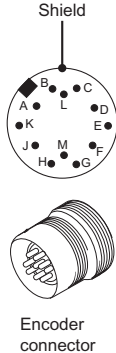
Typical encoder wiring

The figure below shows a typical pulse encoder cable and how the encoder connections relate to the encoder terminals.

Note

Optimum signal clarity is achieved when differential wiring is used between the encoder and encoder module. This is especially useful when situated in a noisy environment or with long cables - however, the module will function correctly both with single ended or differential wiring and as such can tolerate a wire break when differential wiring is used. If the module loses the complete signal on either A or B lines, the inverter will trip with F0090.

Table 1-2 Typical Encoder connections

Encoder pin assignment	1xP8001 Encoder designations	Encoder terminals	Rotary Pulse Encoder 1XP8001-1/Up = 10 V ... 30 V (HTL) 1XP8001-2/Up = 5 V ± 5 % (TTL)
A	U _{a2}	BN	
B	U _p	+ 24 V or + 5 V	
C	U _{a0}	Z	
D	U _{a0}	ZN	
E	U _{a1}	A	
F	U _{a1}	AN	
G	U _{as}	-	
H	U _{a2}	B	
K	0 V	0 V	
L	0 V	-	
M	U _p	-	

The encoder voltage is using the general I/O DIP switches 3 and 4.

The following table shows the possible settings:

Table 1-3 Encoder voltage settings

	On							
	OFF							
								
Encoder supply voltage	0 V		24 V		5 V		24 V	
Encoder type	No encoder		HTL encoder		TTL encoder		HTL encoder	



Warning

DIP switches 3 and 4 in ON position provide a supply voltage of 24 V to the encoder. Therefore it is not allowed to connect a TTL encoder to the inverter if both DIP switches, 3 and 4 are in ON position.

Commissioning (software)

2.1 General commissioning information

General commissioning information

The inverter can be adapted to various applications by changing the parameter values.

The parameter values can be changed, using one of the following optional components:

- The OP (Operator Panel), plugged into the Option port of the Control Unit
- The STARTER (Commissioning software via PC) can be connected to the Option port using a PC connection Kit
- The MMC for downloading complete parameter sets

This section shows how the commissioning of a G120 Inverter is performed using an OP. The commissioning process using STARTER is driven by dialog boxes and will not be described in this manual.

The inverter is delivered with identical factory settings for all CU240S control unit; except the settings of command and setpoint source and values depending on the power module.

Note

Upload and download

- Upload means to save the parameters from the EEPROM of an inverter to a PC (via STARTER), MMC or an OP.
 - Download means to write a parameter set held on a PC, MMC or an OP to the RAM or EEPROM of an inverter.
-

2.2 Parameters

2.2.1 Overview of Parameters

Overview of parameters

The inverter is adapted to a particular application using the appropriate parameters. This means that each parameter is identified by a parameter number and specific attributes (e.g. readable, can be written into, BICO attribute, group attribute etc.). Within any one particular inverter system, the parameter number is unique. On the other hand, an attribute can be assigned a number of times so that several parameters can have the same attribute.

Parameters can be accessed using the following operator units:

- OP
- PC-based commissioning (start-up) tool "STARTER".

There are two main types of parameters; those that can be altered and those that are read-only.

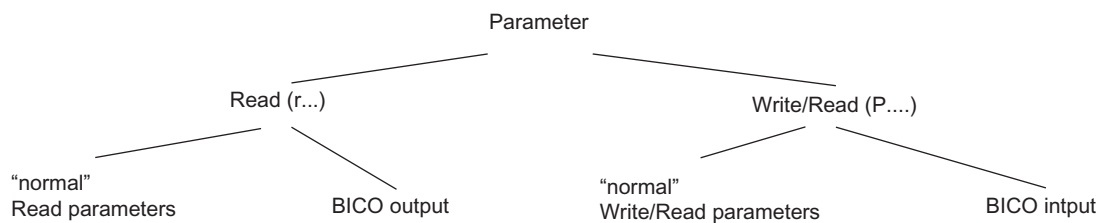


Figure 2-1 Parameter types

2.2.2 Write parameters

Description

Parameters which can be written into and displayed are indicated by the prefix "P".

These parameters directly influence the behaviour of a function. The value of this parameter is saved in non-volatile memory (EEPROM) as long as the appropriate option was selected (non-volatile data save). Otherwise, these values are saved in the volatile memory (RAM) of the processor, which are lost after power failure or power-off/power-on operations.

Examples of the standard notation used throughout our manuals is given below.

Notation examples:

P0970	parameter 970
P0748.1	parameter 748, bit 01
P0819[1]	parameter 819 index 1
P0013[0 ... 19]	parameter 13 with 20 indices (indices 0 to 19)

2.2.3 Monitoring parameters

Description

Parameters which can only be monitored are indicated by the prefix "r".

These parameters are used to display internal quantities, for example states and actual values.

Notation examples:

r0002	monitoring parameter 2
r0052.3	monitoring parameter 52, bit 03
r0947[2]	monitoring parameter 947 index 2
r0964[0 ... 4]	monitoring parameter 964 with 5 indices (indices 0 to 4)

2.2.4 Parameter Attributes

Overview

In the Parameter List, the header line of each parameter shows all the attributes and groups for that specific parameter. The figure below shows the details for parameter P0700 and r1515.

Index	BICO (if exist)
P0700[0...2] CU240S DP/ CU240S DP-F	Selection of command source/Command source se Access level: 3 Quick comm.: NO Can be changed: T Min. 0 P-Group: Commands Activ: YES Unit: - Max. 6 Data type: Unsigned16 Data set: CDS Factory setting 2
CU/PM variants	

Figure 2-2 Description of attributes for parameter P0700

↙ BICO (if exist)			
r1515	CO: Additional torque setpoint/CO: Add. trq. set		
G120	Access level: 3	P-Group: Closed-loop control	Data type: Floating Point
	Unit: -		

Figure 2-3 Description of attributes for parameter r1515

Index

Using the index, a parameter (e.g. p0013[20]) is defined with several consecutive elements (in this case, 20). Each individual index is defined using a numerical value.

When transferred to a parameter this means that an indexed parameter can have several values. The values are addressed using the parameter number including the index value (e.g. p0013[0], p0013[1], p0013[2], p0013[3], p0013[4], ...).

Indexed parameters are used, for example:

- Drive Data Sets (DDS)
- Command Data Sets (CDS)
- Sub functions.

BICO

The following types of connectable parameters are available. A description of BICO technology is given in the functions chapter.

Table 2-1 Parameter attributes - BICO

BICO	Description
BI	Binector Input
BO	Binector Output
CI	Connector Input
CO	Connector Output
CO/BO	Connector Output/Binector Output

Access level

The access level is controlled using parameter P0003. In this case, only those parameters are visible at the OP, where the access level is less than or equal to the value assigned in parameter P0003. On the other hand, for STARTER, only access levels 0 and 3 are relevant. For example, parameters with access level 3 cannot be changed if the appropriate access level has not been set.

The following access levels are implemented in the SINAMICS G120 inverter units:

Table 2-2 Parameter attributes - access level

Access level	Description
0	User-defined parameter list (refer to P0013)
1	Standard access to the most frequently used parameters
2	Extended access, e.g. to inverter I/O functions
3	Expert access only for experienced users
4	Service access only for authorized service personnel – with password protection.

Note

In STARTER, all of the user parameters (access stage 3) are always displayed using the expert list – for the setting p0003 = 0, 1, 2 or 3.

When changing parameters using STARTER, or via a high-level control system, parameter value changes always become immediately effective.

Change state

"P" parameters can only be changed depending on the inverter state. The parameter value is not accepted if the instantaneous state is not listed in the parameter attribute "Change state". For instance, the quick commissioning parameter P0010 with the attribute "CT" can only be changed in quick commissioning "C" or ready "T" but not in operation "U".

Table 2-3 Parameter attributes - Change state

State	Description
C	Quick commissioning
U	Operation (Drive running)
T	Drive ready to run

Data types

The data type of a parameter defines the maximum possible value range. Five data types are used for SINAMICS G120. They either represent an unsigned integer value (U16, U32) or a floating-point value (float). The value range is frequently restricted by a minimum and maximum value (min, max) or using inverter/motor quantities.

Table 2-4 Parameter attributes - Data types

Data type	Description
U16	Unsigned, integer value with a size of 16 bits
U32	Unsigned, integer value with a size of 32 bits
I16	Signed integer 16-bit value
I32	Signed integer 32-bit value
Float	A simple precise floating point value according to the IEEE standard format max. value range: -3.39e+38 – +3.39e+38

Unit

For SINAMICS G120, the units of a particular parameter involve the physical quantity (e.g. m, s, A). Quantities are measurable properties/characteristics of physical objects, operations, states and are represented using characters of a formula (e.g. $V = 9\text{ V}$).

Table 2-5 Parameter attributes - Unit

Unit	Description
-	No dimension
%	Percentage
A	Ampere
V	Volt
Ohm	Ohm
us	Microseconds
ms	Milliseconds
s	Seconds
Hz	Hertz
kHz	Kilohertz
1/min	Revolutions per minute [RPM]
m/s	Meters per second
Nm	Newton meter
W	Watt
kW	Kilowatt
Hp	Horse power
kWh	Kilowatt hours
°C	Degrees Celsius
m	Meter
kg	Kilograms
°	Degrees (angular degrees)

Grouping

The parameters are sub-divided into groups according to their functionality. This increases the transparency and allows a quicker and more efficient search for specific parameters. Furthermore, parameter P0004 can be used to control the specific group of parameters that are displayed on the OP.

Table 2-6 Parameter attributes - Grouping

Grouping	Description		Main parameter area:
ALWAYS	0	all parameters	
INVERTER	2	inverter parameters	0200 ... 0299
MOTOR	3	motor parameters	0300 ... 0399 and 0600 ... 0699
ENCODER	4	speed encoder	0400 ... 0499
TECH_APL	5	technical applications/units	0500 ... 0599
COMMANDS	7	control commands, digital I/O	0700 ... 0749 and 0800 ... 0899
TERMINAL	8	Analog inputs/outputs	0750 ... 0799
SETPOINT	10	Setpoint channel and ramp-function gen.	1000 ... 1199
Safety functions		Fail-safe	9000 ... 9999
FUNC	12	Inverter functions	1200 ... 1299
CONTROL	13	Motor open-loop/closed-loop control	1300 ... 1799
COMM	20	Communications	2000 ... 2099
ALARMS	21	Faults, warnings, monitoring functions	2100 ... 2199
TECH	22	Technology controller (PID controller)	2200 ... 2399

Active

This attribute is only of importance in conjunction with an OP. The "Yes" attribute indicates that this value is already accepted when scrolling (when changing the value with  or ). Especially parameters which are used for optimization functions have this property (e.g. constant voltage boost P1310 or filter time constants). On the other hand, for parameters with the attribute "First confirm", the value is only accepted after first pressing the key

. These include, for example, parameters where the parameter value can have different settings/meanings (e.g. selecting the frequency setpoint source P1000).

Table 2-7 Parameter attributes - Active

Active	Description
Yes	The value becomes valid by either scrolling with  or 
First confirm	The value is only accepted by pressing 

Note

Parameter values that are changed using STARTER or a higher-level control do not have to be acknowledged.

Quick commissioning

This parameter attribute identifies as to whether the parameter is included in the quick commissioning (QC) (P0010 = 1).

Table 2-8 Parameter attributes - Quick commissioning

QC	Description
No	The parameter is not included in the quick commissioning
Yes	The parameter is included in the quick commissioning

Value range

The value range, which is specified as a result of the data type, is restricted by the minimum and maximum values (min, max) and using the inverter/motor quantities. Straightforward commissioning is guaranteed in so much that the parameters have a default value. These values (min, max, def) are permanently saved in the inverter and cannot be changed by the user.

Table 2-9 Parameter attributes - Value range

Value range	Description
-	No value entered (e.g.: "r parameter")
Min	Minimum value
Max	Maximum value
Def	Default value

Data sets

A detailed description for the data sets is given in the respective section

Table 2-10 Data sets

BICO	Description
CDS	Command data set
DDS	Drive data set

2.3 Factory settings

Factory default settings

The inverter system is shipped from the factory as a Control Unit and a Power Module. The Control Unit has three or seven LEDs (depending on the type of Control Unit) on the front panel which display the operating state of the inverter. For commissioning and operation the control unit has to be fitted to the power module as shown in section 4.

After a factory reset, the inverter can be operated without additional parameterization if the inverter default settings (which depend on the inverter type and size) match the following data of a 4-pole motor:

Default line supply frequency	50 Hz
Rated motor voltage	P0304
Rated motor current	P0305
Rated motor power	P0307
Rated motor frequency	P0310
Rated motor speed	P0311
(A Siemens standard motor is recommended.)	
Further, the following conditions must be fulfilled:	
Control (ON/OFF command) using digital inputs (CU240S)	See pre-assigned inputs below.
Asynchronous motor	P0300 = 1
Self-cooled motor	P0335 = 0
Motor overload factor	P0640 = 150 %
Setpoint input using analog input 1	P1000 = 2
Min. frequency	P1080 = 0 Hz
Max. frequency	P1082 = 50 Hz
Ramp-up time	P1120 = 10 s
Ramp-down time	P1121 = 10 s
Linear V/f characteristic	P1300 = 0

Table 2-11 Pre-assignment of the digital inputs for a CU240S *)

Digital Inputs	Terminals	Parameter	Function	Active
Command source*	-	P0700 = 2	Terminals	Yes
Digital Input 0, DI0	5	P0701 = 1	ON/OFF1	Yes
Digital Input 1, DI1	6	P0702 = 12	Reversing	Yes
Digital Input 2, DI2	7	P0703 = 9	Fault acknowledge	Yes
Digital Input 3, DI3	8	P0704 = 15	Fixed setpoint (direct)	No
Digital Input 4, DI4	16	P0705 = 16	Fixed setpoint (direct)	No
Digital Input 5, DI5	17	P0706 = 17	Fixed setpoint (direct)	No
Digital Input 6, DI6	40	P0707 = 18	Fixed setpoint (direct)	No
Digital Input 7, DI7	41	P0708 = 0	Digital input disabled	No
Digital Input 8, DI8	42	P0709 = 0	Digital input disabled	No
*) With CU240S DP and CU240S DP-F control units, P0700 and P1000 are set to 6 (command source and setpoint source via PROFIBUS-DP).				

If all the installation and commissioning requirements are met and the motor data matches the inverter data, the following is possible with the factory settings, when using a control unit CU240S:

To start and stop the motor	Using DI0 with external switch
To reverse direction of rotation	Using DI1 with external switch
To reset faults	Using DI2 with external switch
To enter a frequency setpoint	Using AI0 with external potentiometer; the default setting of the AI: Voltage input
To display the actual frequency value	Using AO0 as current output

The potentiometer and the external switches can be connected through the inverter internal power supply, as shown in section "Connecting the Control Unit via terminals".

Notice

If settings have to be made which go beyond the factory settings, then depending on the complexity of the application, when commissioning the inverter, the particular function description as well as the parameter list including function charts must be carefully taken into consideration.

2.4 Parameterization with Operator Panel

2.4.1 Handling of the Operator Panel

The Operator Panel (OP)

The OP is available as an option to enhance the effectiveness of parameterizing and control of the inverter. The control signals and speed reference can easily be set by pressing the appropriate buttons. The OP has the ability to upload and download parameter sets from an inverter to another inverter.



Figure 2-4 Operator Panel (OP, 6SL3255-0AA00-4BA1)

Fitting the OP to the Control Unit

The OP is fitted to the Control Unit as shown in the figure below. No matter which class of Control Unit is being used, the process is the same.

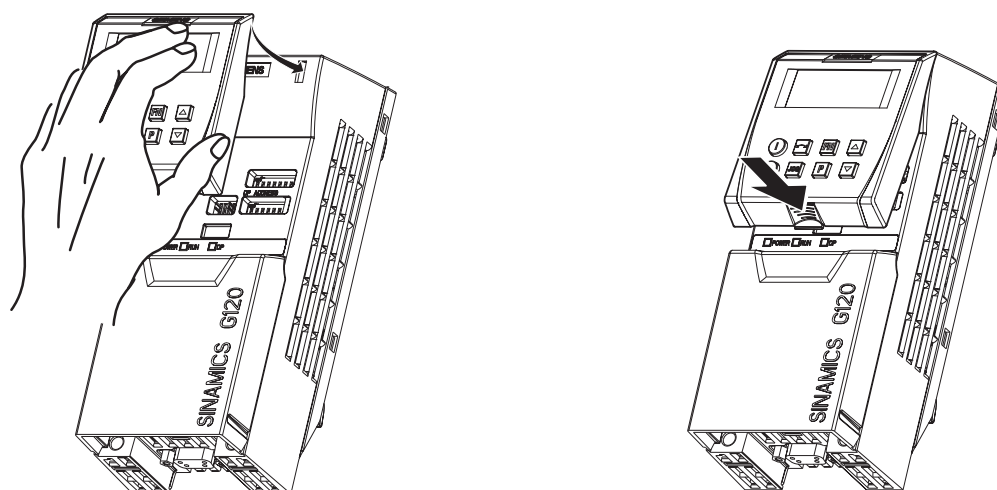


Figure 2-5 Fitting the OP to the CU

2.4.2 Function Keys of the OP

Operator Panel - function keys

Table 2-12 OP keys and their functions

Operator Panel Key	Function	Effects	
	Status display	The LCD indicates the settings which the drive inverter is presently using.	
	Start motor	The inverter is started by pressing the key. This key is deactivated in the default setting. Parameter P0700 or P0719 should be changed as follows to activate the key: OP: P0700 = 1 or P0719 = 0 ... 16	
	Stop motor	OFF1	When this key is pressed, the motor comes to a standstill within the selected ramp-down time. It is deactivated in the default setting; to activate → refer to the "Start motor" key.
		OFF2	The motor coasts down to a standstill by pressing the key twice (or pressing once for a longer period of time). This function is always activated.
	Direction reversal	To reverse the direction of rotation of the motor, press this key. The opposing direction is displayed using the minus character (-) or by the flashing decimal point. In the default setting this function is deactivated. To activate it → refer to the "Start motor" key.	
	Jog motor	In the "Ready to power-on" state, when this key is pressed, the motor starts and rotates with the pre-set jog frequency. The motor stops when the key is released. When the motor is rotating, this key has no effect.	
	Function	This key can be used to display additional information. If you press the key during operation, independent of the particular parameter, for two seconds, the following data will be displayed: 1. Voltage of the DC current link (designated by d – units V). 2. Output current (A) 3. Output frequency (Hz) 4. Output voltage (designated by o – units V). 5. The value, selected in P0005 (if P0005 is configured so that one of the above pieces of data is displayed (1 to 4), then the associated value is not re-displayed). The displays mentioned above are run-through one after the other by pressing again. Step function Starting from any parameter (rXXXX or PXXXX), if the key Fn is briefly pressed, then a jump is immediately made to r0000. You can then, when required, change an additional parameter. After returning to r0000, when key Fn is pressed, then the system returns to the starting point. Acknowledgement If alarm and fault messages are present, then these can be acknowledged by pressing key Fn.	
	Parameter access	Parameters can be accessed by pressing this key.	
	Increase value	When this key is pressed, the displayed value is increased.	
	Reduce value	When this key is pressed, the displayed value is decreased.	

2.4.3 Changing parameters via OP

Changing parameter with the OP

The description below serves as an example that shows how to change any parameter using the OP.

Table 2-13 Changing P0003 - parameter access level

	Step	Result on display
1	Press P to access parameters	r0000
2	Press ▲ until P0003 is displayed	P0003
3	Press P to display the parameter value	1
4	Press ▲ or ▼ to set the required value (set to 3)	3
5	Press P to confirm and store the value	P0003
6	All level 1 to level 3 parameters are now visible to the user.	

Table 2-14 Changing P0719 an index parameter - setting OP control

	Step	Result on display
1	Press P to access parameters	r0000
2	Press ▲ until P0719 is displayed	P0700
3	Press P to access the parameter value	0000
4	Press ▲ or ▼ to select index 1	0001
5	Press P to display actual set value	0
6	Press ▲ or ▼ to the required value	11
7	Press P to confirm and store the value	P0700
8	Press ▼ until r0000 is displayed	r0000
9	Press P to return the display to the standard drive display (as defined by the customer)	

Note

The OP sometimes displays "bUSY" when changing parameter values. This means that the inverter is presently handling another higher-priority task.

2.5 Parameterization with MMC

Overview

A G120 inverter can be parameterized by downloading a parameter set from the MMC to the inverter.

The download can be performed as

- manual download
- automatic download
- start-up download

A detailed download description can be found in the operation section.

2.6 Parameterization with STARTER

2.6.1 Commissioning with STARTER

Commissioning with STARTER

The following interfaces - which are Control Unit dependent are available:

Table 2-15 Connection possibilities for STARTER

Type	USS on RS232	USS on RS485	PROFIBUS DP
PC connected to CU via	PC Connection Kit	Sub D cable & RS485 to RS232 converter	DP interface
Interface	Option port	Sub D connector	Sub D connector
Restrictions	Peer to peer	up to 31 slaves	up to 125 slaves
CU240S	X	X	--
CU240S DP	X	--	X
CU240S DP-F	X	--	X

General information for connecting STARTER

USS address: see P2011, default setting P2011 = 0

USS baudrate: see P2010, default setting P2010 = 8 ($\pm$ 38400 baud)

PROFIBUS-DP address: see P0918 or PROFIBUS-DP DIP switches.

STARTER projects

Using STARTER either a new project can be created or an already existing project can be opened.

To create a new project in STARTER one of the following methods can be used:

- Search inverter
- Wizard
- Select inverter.

When opening an existing project or creating a new project STARTER is in the offline mode. To go online the button  has to be pressed.

Changing parameters with STARTER

Parameters can be changed online or offline (online preferred).

Online parameter changes are stored in the RAM of the inverter. A manual transfer from RAM to EEPROM can be triggered by pressing . When closing STARTER and the contents of the RAM and EEPROM are different, the user is asked whether or not they wish to transfer the RAM data to the EEPROM.

Note

Via P0014 the store mode can be changed,

- P0014 = 0: parameter changes stored in RAM (default)
 - P0014 = 1: parameter changes stored in EEPROM
-

Parameter sets that have been changed offline can be transferred to the inverter using the download  button.



Caution

Parameters for fail-safe functions can only be changed in the online mode.

When downloading parameters via STARTER, parameters belonging to fail-safe functions will not be downloaded.

2.7 Commissioning modes

2.7.1 Commissioning overview

Commissioning overview

A differentiation is made between the following scenarios when commissioning the inverter via OP:

- Quick commissioning
- Motor data identification
- Calculating the motor/control data
- Commissioning the application
- Series commissioning.

When commissioning, initially, a quick or series commissioning should be carried-out. In case of commissioning the inverter with STARTER this means "reconfigure Drive". The actual "Commissioning the application" should actually only be commissioned if the inverter-motor combination provides a satisfactory result.

If the inverter is to be commissioned from a defined state, then the inverter can be reset to its initial state when it left the factory. This is accomplished by a reset of all the parameters back to the original factory settings; this is called a "Factory Reset".

The following check list should help you to commission the Inverter without any problems and to guarantee a high degree of availability:

- When handling the inverter, carefully observe all of the ESD measures.
- All of the screws must have been tightened up to their specified torque.
- All connectors and option modules must have been correctly inserted, locked or screwed into place.
- All of the components are grounded/earthed at the points provided and all of the shields have been connected.
- The Inverter has been designed for defined mechanical, climatic and electrical ambient conditions. It is not permissible that the specified limit values are exceeded in operation or when the Inverters are being transported. The following must be carefully observed:
 - Line supply conditions
 - Pollutant stressing
 - Gases which can have a negative impact on the function
 - Ambient climatic conditions
 - Storage/transport
 - Shock stressing
 - Vibration stressing
 - Ambient temperature
 - Installation altitude.

In addition, to carrying-out all of the installation work, an important prerequisite for successful commissioning is that the Inverter is not disconnected from the line supply while being parameterized. If a line supply failure interrupts commissioning, then inconsistencies can occur regarding the parameterization. In this case, it is important that the commissioning is re-started, possibly with a factory reset to establish the original factory settings.

Notice**Behaviour of inverter on completion of commissioning**

The following behaviour should be taken into account when commissioning the inverter:

- standard commissioning with P0014 = 0:
Parameters are only stored in RAM. RAM -> EEPROM can be started:
 - with OP: via setting P0971 = 1
 - with SATRTER in the online mode: via pressing 
RAM -> EEPROM will automatically be performed when starting data transfer from inverter to MMC (P0802 = 2).
 - standard commissioning with P0014 = 1:
All parameter changes will be saved in both RAM and EEPROM.
 - While commissioning the fail-safe functions - only possible with a CU240S DP-F - the relating parameters are automatically stored in RAM and EEPROM
 - Data from EEPROM can be transferred to MMC via P0802 = 2.
 - Parameters can be changed independent whether an MMC is plugged in or not.
Depending on the settings in P8458 after power cycle the parameters from EEPROM or MMC are used for start up. The customer has to take of the proper settings of P8458.
 - P8458 = 0, no automatic parameter download from the MMC.
 - P8458 = 1, automatic parameter download from the MMC only at the first start-up of the CU with plugged-in MMC
 - P8458 = 2, automatic parameter download from the MMC after each start-up of the CU with plugged-in MMC.
-



Warning

In case of automatic parameter download from the MMC at start up, F0395 will be generated.

In standard applications a confirmation test, in fail-safe applications an acceptance test has to be performed.

2.7.2 Quick commissioning

Description

If there is still no appropriate parameter set for the drive, then a quick commissioning must be carried-out for the closed-loop vector control and for the V/f control including a motor data identification routine. The following operator units can be used to carry-out quick commissioning:

- OP (option)
- PC Tools (with commissioning program STARTER).

When the quick commissioning is carried-out, the motor-drive inverter is basically commissioned; the following data must be obtained, modified or entered before quick commissioning is started:

- Enter the line supply frequency
- Enter the rating plate data
- Command/setpoint sources
- Min./max. frequency or ramp-up/ramp-down time
- Closed-loop control mode
- Motor data identification.

Parameterizing the inverter with OP

The frequency inverter is adapted to the motor using the quick commissioning function and important technological parameters are set. The quick commissioning shouldn't be carried-out if the rated motor data saved in the inverter (4-pole 1LA Siemens motor, star circuit configuration inverter (FU)-specific) match the rating plate data.



Warning

The motor data identification routine **MUST** not be used for loads which are potentially hazardous (for example, suspended loads for crane applications). Before the motor data identification routine is started, the potentially hazardous load must be carefully secured (for example, by lowering the load to the floor or by clamping the load using the motor holding brake).

The possible rating plate data is shown in the figure below. The precise definition and explanation of this data is defined in DIN EN 60034-1.

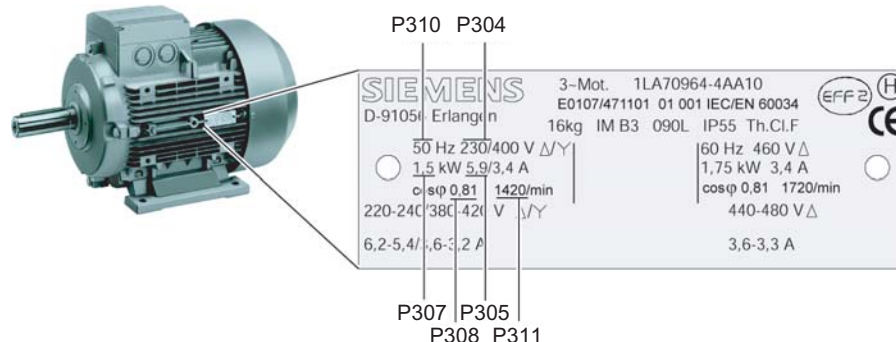


Figure 2-6 Example of typical motor rating plate

2.7.3 Quick Commissioning - flow chart

Performing Quick Commissioning via OP

For applications using V/f (P1300 = 0 [default]) or Flux Current Control (FCC) (P1300 = 1 or 6), quick commissioning can be accomplished by setting the following parameters:

Enter the motor frequency	P0100
Enter the rating label data P0304,	P0304, P0305, P0307, P0310 and P0311
Command and setpoint sources	P0700, P1000
Minimum and maximum frequency	P1080, P1082
Ramp-up and ramp-down times	P1120, P1121
Closed-loop control mode	P1300
Motor data identification	P1900 = 3

For applications using Vector Control (P1300 = 20 ... 23), the parameters in the following flow chart should be set and used:

Parameters designated with an "*" offer more settings than are actually shown here. Refer to the Parameter list for additional settings.

Table 2-16 Quick commissioning - flow chart

Parameter	Action/Description (Factory setting: bold) Parameters with an "*" have more settings than listed below. Please refer to the parameter list	Your own setting
P0003 = 3	User access level* 1: Standard: Allows access into most frequently used parameters 2: Extended: Allows extended access e.g. to inverter I/O functions 3: Expert: For expert use only	
P0004 = 0	Parameter filter* 0: All parameters 2: Inverter 3: Motor 4: Speed sensor	
P0010 = 1	Commissioning parameter filter* 0: Ready 1: Quick commissioning 30: Factory setting Note: P0010 should be set to 1 in order to parameterize the data of the motor rating plate.	
P0100 = 0	Europe/North America (enter the motor frequency) 0: Europe [kW], frequency default, 50 Hz 1: North America [hp], frequency default, 60 Hz 2: North America [kW], frequency default, 60 Hz	
P0205 = 0	Inverter application (enter the required overload) 0: High overload (for compressors, processing machines, etc.) 1: Light overload (for pumps and fans, etc.) Note: This parameter is only effective for Inverters ≥ 5.5 kW/400 V.	
P0300 = 1	Select motor type 1: Asynchronous rotational motor 2: Synchronous rotational motor (Note: only V/f control types (P1300 < 20) are permitted)	
P0304 = ?	Rated motor voltage (enter value from the motor rating plate in V) The input of rating plate data must correspond with the wiring of the motor (star/delta). This means, if delta wiring is used for the motor, delta rating plate data has to be entered.	
P0305 = ?	Rated motor current enter value from the motor rating plate in A	
P0307 = ?	Rated motor power enter value from the motor rating plate in kW or hp Note: if P0100 = 0 or 2, data is in kW and if P0100 = 1, data is in hp.	
P0308 = ?	Rated motor cosPhi (only visible if P0100 = 0 or 2) enter cos ϕ from the motor rating plate. Setting P0308 = 0 causes internal calculation of value.	
P0309 = ?	Rated motor efficiency (only visible if P0100 = 1) enter value (%) from the motor rating plate. Setting P0309 = 0 causes internal calculation of value	
P0310 = ?	Rated motor frequency enter value from the motor rating plate in Hz Pole pair number recalculated automatically if parameter is changed.	
P0311 = ?	Rated motor speed enter value from the motor rating plate in RPM) Setting P0311 = 0 causes internal calculation of value. Note: Required for vector control and V/f control with speed controller. Slip compensation in V/f control requires rated motor speed for correct operation.	
P0314 = ?	Motor pole pair number 1: 2-pole motor	

Parameter	Action/Description (Factory setting: bold) Parameters with an "*" have more settings than listed below. Please refer to the parameter list	Your own setting
	2: 4-pole motor Recalculated automatically when P0310 (rated motor frequency) or P0311 (rated motor speed) is changed.	
P0320 = ?	Motor magnetizing current Setting P0320 = 0 causes calculation according the setting of P0340 = 1 (data entered from rating plate) or by P3900 = 1, 2 or 3. The calculated value is displayed in parameter r0331.	
P0335 = 0	Motor cooling 0: Self-cooled using shaft mounted fan attached to the motor 1: Force-cooled, using a separately powered cooling fan 2: Self-cooled and internal fan 3: Force-cooled and internal fan	
P0400 = 0	Select encoder type 0: Disabled 2: Quadrature encoder no zero pulse 12: Quadrature encoder & zero pulse Note: Encoders with zero pulse can also be connected, but the zero pulse is not used.	
P0408 = ?	Encoder pulses per revolution Specifies the number of encoder pulses per revolution (encoder resolution) Note: The encoder resolution is limited by the max. pulse frequency of the encoder circuits (f_max = 300 kHz).	
P0500 = 0	Technological application Selects technological application 0: High overload 1: Light overload (for pumps and fans, etc. sets internally P1300 = 2)	
P0610 = 2	Motor I2t temperature reaction Defines reaction when motor temperature reaches warning threshold. 0: No reaction, warning only 1: Warning and I _{max} reduction 2: Warning and trip (F0011)	
P0625 = ?	Ambient motor temperature Ambient temperature of motor at time of motor data identification. Note: It is only allowed to change the value when the motor is cold. A motor identification has to be made after changing the value.	
P0640=150	Motor overload factor Defines motor overload current limit [%] relative to P0305 (rated motor current). This defines the limit of the maximum output current as a percentage of the rated motor current (P0305). This parameter is set, using P0205 for high overload, to 150 % and for light overload, up to 110 %.	
P0700 = 2	Selection of command source* enter the command source 0: Factory default setting 1: OP (keypad) 2: Terminal (Default for CUS240S) 4: USS on RS232 5: USS on RS485 6: Fieldbus (Default for CUS240S DP and CUS240S DP-F)	
P0727 = 0	Selection of 2-/3-wire method Determines the control method using the terminals. 0: Siemens (start/dir) 1: 2-wire(fwd/rev) 2: 3-wire(fwd/rev)	

Parameter	Action/Description (Factory setting: bold) Parameters with an "" have more settings than listed below. Please refer to the parameter list	Your own setting
	3: 3-wire(start/dir)	
P1000 = 2	Selection of frequency setpoint* enter the frequency setpoint source 0: No main setpoint 1: MOP setpoint 2: Analog setpoint (Default for CUS240S) 3: Fixed frequency 4: USS on RS232 5: USS on RS485 6: Fieldbus (Default for CUS240S DP and CUS240S DP-F) 7: Analog setpoint 2	
P1080 = ?	Minimum frequency Enter the lowest motor frequency (in Hz) to which the motor operates independently of the frequency setpoint. The value set here is valid for both clockwise and anticlockwise rotation.	
P1082 = ?	Maximum frequency Enter the maximum frequency (in Hz) to which the motor is limited independently of the frequency setpoint. The value set here is valid for both clockwise and anticlockwise rotation.	
P1120 = ?	Ramp-up time Enter the time (in seconds) in which the motor should accelerate from standstill up to maximum motor frequency P1082. If the ramp-up time is set too short, this can cause alarm A0501 (current limit value) or tripping the inverter with fault F0001(overcurrent).	
P1121 = ?	Ramp-down time Enter the time (in seconds) in which the motor should decelerate (using braking) from the maximum frequency P1082 down to standstill. If the ramp-down time is set too short, this can cause alarm A0501 (current limit value) or A0502 (overvoltage limit value) or tripping the inverter with fault F0001 (overcurrent) or F0002 (overvoltage).	
P1135 = ?	OFF3 ramp-down time Enter the time (in seconds) in which the motor should decelerate (using braking) from the maximum frequency P1082 down to standstill with an OFF3 command (fast stop). If the ramp-down time is set too short, this can cause alarm A0501 (current limit value) or A0502 (overvoltage limit value) or tripping the inverter with fault F0001 (overcurrent) or F0002 (overvoltage).	
P1300 = 0	Control mode* enter the required control mode 0: V/f with linear characteristic 1: V/f with FCC 2: V/f with parabolic characteristic 3: V/f with programmable characteristic 20: Sensorless vector control 21: Vector control with sensor 22: Sensorless vector torque-control	
P1500 = 0	Selection of torque setpoint* enter the source for the torque setpoint 0: No main setpoint 2: Analog setpoint 4: USS on RS232 5: USS on RS485 6: Fieldbus	
P3900 = ?	End quick commissioning (QC)* 0: No quick commissioning (no motor calculations) 1: Motor calculation and reset of all parameters that haven't been changed to factory settings while QC process.	

Parameter	Action/Description (Factory setting: bold) Parameters with an "*" have more settings than listed below. Please refer to the parameter list	Your own setting
	2: Motor calculation and reset of all I/O settings to factory settings. 3: Only motor calculation - other parameters are not reset. Note: If P3900 = 1, 2, or 3 P0340 is set to 1 and the value from P1082 is written into P2000. The appropriate motor data will be calculated. While end of quick commissioning is performed "bUSY" will be displayed on the OP. This means that the control data are being calculated and the respective parameter values are stored in the EEPROM. After quick commissioning has been completed, P3900 and P0010 will be set to 0.	
END	End of the quick commissioning/Inverter setting If additional functions must be implemented for the Inverter, please use the instructions Adaption to the application and Technological interconnections . We recommend this procedure for motors with a high dynamic response.	

Next to "Quick Commissioning" the "Motor Data Identification" and additionally in case of vector mode (P1300 = 20/21) the "Speed Control Optimisation" should be performed.

Both need an ON command to start.

Motor data identification

P0010 = 0	Commissioning parameter filter* Check if P0010 = 0 (Ready)	
P1900 = 3	Select motor data identification* 0: Disabled 2: Identification of all parameters in standstill. 3: Identification of all parameters in standstill including saturation curve	
ON command	Start motor data identification Once P1900 ≠ 0, alarm A0541 (motor data identification active) is generated that states, the next ON command will initiate the motor data identification. When the ON Command is given, current flows through the motor and the rotor aligns itself. Note: When motor data identification is complete A0541 will be cleared and P1900 will be set to zero.	

Speed control optimisation

P0010 = 0	Commissioning parameter filter* Check if P0010 = 0 (Ready)	
P1960 = 1	Speed control optimisation 0: Disable 1: Enable	
ON command	Start Speed control optimisation We recommend the Speed control optimisation if vector mode (P1300 = 20 or 21) is selected. Once P1960 = 1, alarm A0542 is generated, that states, the next ON command will initiate the optimisation. If there is a problem with speed control optimisation due to instability the drive may trip with fault F0042, because no stable value has been obtained on the ramp up within a reasonable time. Note: When Speed control optimisation is complete A0542 will be cleared and P1960 will be cleared to zero.	

2.7.4 Calculating the motor and control data

Overview

Internal motor/control data is calculated using parameter P0340 or, indirectly using parameter P3900 or P1910. The functionality of parameter P0340 can, for example, be used if the equivalent circuit diagram data or the moment of inertia values are known. The following settings are possible for P0340:

- 0 No calculation
- 1 Complete parameterization
- 2 Calculation of the equivalent circuit diagram data
- 3 Calculation of V/f and Vector control
- 4 Calculation of the controller settings

For the complete parameterization (P0340 = 1), in addition to the motor and control parameters, parameters are also pre-assigned which refer to the motor rated data (for example, torque limits and reference quantities for interface signals). A complete list of all of the parameters depending on P0340 is included in the parameter manual.

When calculating the motor/control data using P0340, there are different scenarios, which can be called-up as a function of the known data.

Note

When exiting quick commissioning with P3900 > 0, internally P0340 is set to 1 (complete parameterization).

For the motor data identification, after the measurement has been completed, internally P0340 is set to 3.

2.7.5 Calculating the motor and control data - flow chart

Performing the calculation of motor and control data via OP

Parameter	Description	Your setting
P0340 = 1	Calculation of motor parameters This parameter is required during commissioning in order to optimize the operating behavior of the inverter. For the complete parameterization (P0340 = 1), in addition to the motor/control parameters, parameters are pre-assigned which refer to the rated motor data (e.g. torque limits and reference quantities for interface signals). A list of the parameters, which are calculated, depending on the setting of P0340, are included in the parameter list. 0: No calculation 1: Complete parameterization 2: Calculation of equivalent circuit data 3: Calculation of V/f and Vector control data 4: Calculation of controller settings only	
If additional catalog data is known enter the data in P0341, P0342 and P0344.		
P0341 = ?	Motor inertia [kg*m ²]	
P0342 = ?	Total/motor inertia ratio	
P0344 = ?	Motor weight (entered in kg)	
If the ECD data is known, enter the data in P0350, P0354, P0356, P0358, P0360. If the ECD data is not known, then: Set P0340 = 4. To calculate the controller settings and skip to END.		
P0350 = ?	Stator resistance (line-to-line) (entered in Ω) Stator resistance in Ω of the motor which is connected (from line-to-line). This parameter value also includes the cable resistance.	
P0354 = ?	Rotor resistance (entered in Ω) Defines the rotor resistance of the motor equivalent diagram (phase value).	
P0356 = ?	Stator leakage inductance (entered in mH) Defines the stator leakage inductance of the motor equivalent diagram (phase value).	
P0358 = ?	Rotor leakage inductance (entered in mH) Defines the rotor leakage inductance of the motor equivalent diagram (phase value).	
P0360 = ?	Main inductance (entered in mH) Defines the main (magnetizing) inductance of the motor equivalent diagram (phase value).	
P0340 = 3	Calculation of motor parameters 3: Calculation of V/f and Vector control All of the parameters, dependent on the ECD data are calculated and, in addition, the controller settings (P0340 = 4).	
END	The motor parameters have been calculated and it is now possible to return to the additional parameterization in the Section "Adaptation to the application".	

2.7.6 Motor data identification

Motor identification data

The Inverter has a measuring technique which is used to determine the motor parameters:

Equivalent circuit diagram (ECD)	→	P1910 = 1
Magnetizing characteristic (saturation curve)	→	P1910 = 3

For control-related reasons, it is essential that the motor data identification is performed. Without performing the motor data identification it is only possible to estimate ECD data using information from the motor rating plate. For example, the stator resistance is extremely important for the stability of the closed-loop Vector control and for the voltage boost of the V/f characteristic. The motor data identification routine should be executed, especially if long feeder cables or if third-party motors are being used.

If the motor data identification routine is being started for the first time, then the following data is determined, starting from the rating plate data (rated [nominal] data) with P1910 = 1:

- ECD data
- Motor cable resistance
- IGBT on-state voltage and compensation of IGBT gating dead times.

The rating plate data represents the initialization values for the identification. This is the reason that it is necessary to have the correct input from the rating plate data when determining the data specified above.

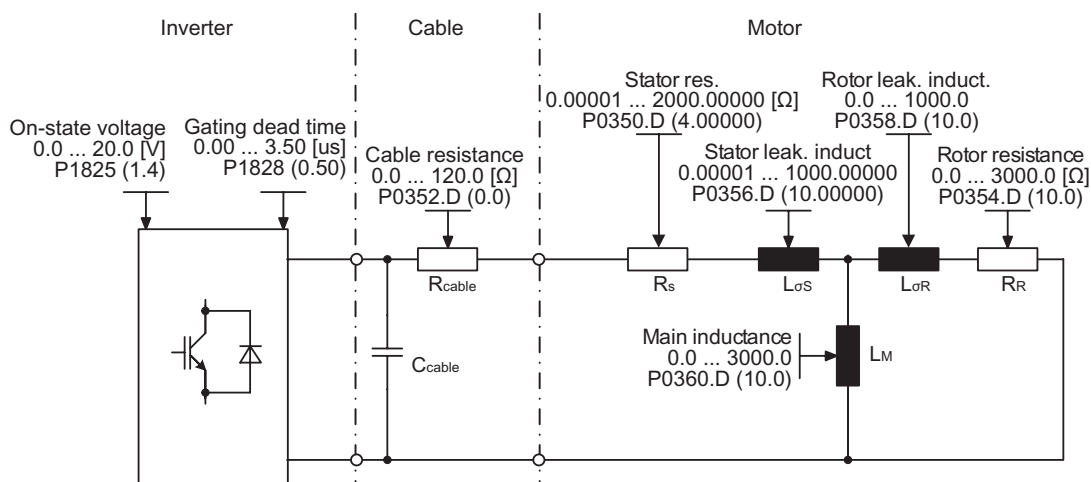


Figure 2-7 Equivalent circuit diagram (ECD)

In addition to the ECD data, the motor magnetizing characteristic (see the figure above) can be determined using the motor data identification (P1910 = 3). If the motor combination is operated in the field-weakening range (which is above the nominal frequency of the motor), then this characteristic should be determined, especially when Vector control is being used. As a result of this magnetizing characteristic, the Inverter can, in the field-weakening range, accurately calculate the current which is generated in the field and in-turn achieve a higher torque accuracy.

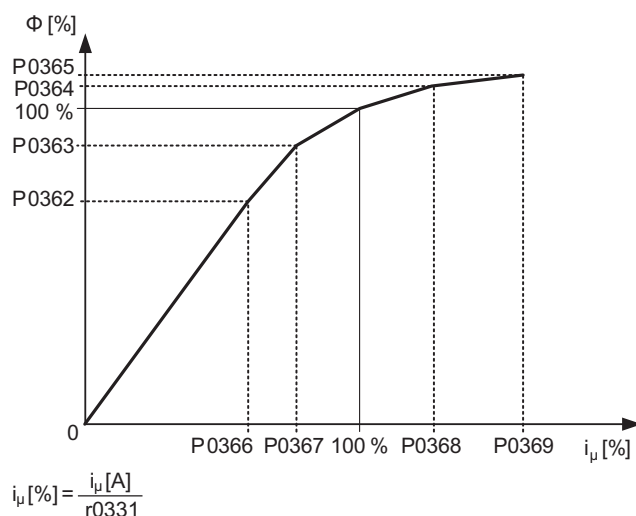


Figure 2-8 Magnetizing characteristic

After selecting the motor data identification using parameter P1910, alarm A0541 is immediately generated. The motor identification routine is started by the ON command and different excitation signals are impressed in the motor (DC and AC voltages). This measurement is carried-out with the motor at a standstill and it takes, including the data calculation per selection (P1910 = 1 or 3), between 20 seconds and 4 minutes to complete. The identification time depends on the motor and increases with its size (this takes approx. 4 min. for a 200 kW motor).

The motor data identification routine must be carried-out with the motor in the **cold** condition so that the motor resistance values saved can be assigned to the parameter of the ambient temperature P0625. Only then is the correct temperature adaptation of the resistances possible during operation.

The motor data identification routine operates with the results of the "Complete parameterization" P0340 = 1 or the motor equivalent diagram data which was last saved. The results become increasingly better the more times that the identification routine is executed (up to 3 times).



Warning

It is not permissible to carry-out the motor identification routine for loads which are potentially hazardous (e.g. suspended loads for crane applications). Before starting the motor data identification routine, the potentially hazardous load must be secured (e.g. by lowering the load to the floor or clamping the load using the motor holding brake).

When starting the motor data identification routine, the rotor can move into a preferred position. This is more significant for larger motors.

Note

The equivalent circuit data (P0350, P0354, P0356, P0358, P0360), with the exception of parameter P0350, should be entered as phase values. In this case, parameter P0350 (line-to-line value) corresponds to twice the phase value.

The motor cable resistance P0352 is defined as a phase value.

During the motor identification routine, the stator resistance and the motor cable resistance are determined and entered into parameter P0350. If a correction is made in parameter P0352, then the Inverter defines the motor cable resistance using the following relationship: $P0352 = 0.2 * P0350$.

If the motor cable resistance is known, then the value can be entered into parameter P0352 after the motor data identification. The stator resistance is appropriately reduced as a result of this entry and is therefore more precisely adapted to the actual application.

It is not necessary to lock the motor rotor for the motor data identification routine. However, if it is possible to lock the motor rotor during the identification routine (i.e. by closing the motor holding brake), then this should be used to determine the equivalent circuit diagram data.

The following formula can be applied to check the correctness of the motor rating plate data:

$$P_N = \sqrt{3} * V_{NY} * I_{NY} * \cos\phi * \eta \approx \sqrt{3} * V_{N\Delta} * I_{N\Delta} * \cos\phi * \eta$$

Where:

P_N	rated motor power
$V_{NY}, V_{N\Delta}$	rated motor voltage (star/delta)
$I_{NY}, I_{N\Delta}$	rated motor current (star/delta)
$\cos\phi$	power factor
η	efficiency

If Problems occur during the identification run, for example, the current controller oscillates, then the rating plate data should be re-checked and an approximately correct magnetizing current P0320 entered. The motor data identification routine should then be re-started by called P0340 = 1.

2.7.7 Motor data identification - flowchart

Motor data identification - flow chart

Parameter or Action	Description (Factory setting: Bold)
P0625 = ?	Ambient motor temperature (entered in °C) The motor ambient temperature is entered at the instant that motor data is being determined (factory setting: 20 °C). The difference between the motor temperature and the motor ambient temperature P0625 must lie in the tolerance range of approx. ± 5 °C. If this is not the case, then the motor data identification routine can only be carried-out after the motor has cooled down.
Is the motor temperature (P0625) within the tolerance described above. If not the motor must be allowed to cool down.	
P1910 = 1	Select motor data identification 0: Disabled 1: Identification of all parameters that have change. These changes are applied to the controller. 3: Identification of saturation curve with parameter change
Note: For P1910 = 1 → P0340 is internally set to 3 and the appropriate data calculated (refer to parameter list P0340)	
ON	Power-up the motor The measuring operation must be started with a continuous ON command. If so doing the motor aligns itself and conducts current. Diagnostics via r0069 (CO: phase currents) is possible. Alarm message A0541 (motor data identification routine active) is output.
A0541	After the motor data identification routine has been completed: 1. P1910 is reset (P1910 = 0) 2. A0541 is withdrawn
OFF1	In order to set the inverter into a defined state, an OFF1 command must be issued before the next step.
P1910 = 3	Select motor data identification 0: Disabled 1: Identification of all parameters that have change. These changes are applied to the controller. 3: Identification of saturation curve with parameter change
Note: For P1910 = 3 → P0340 is internally set to 2 and the appropriate data calculated (refer to parameter list P0340)	
ON	Power-up the motor The measuring operation must be started with a continuous ON command.
A0541	After the motor data identification routine has been completed: 1. P1910 is reset (P1910 = 0) 2. A0541 is withdrawn
OFF1	In order to set the inverter into a defined state, an OFF1 command must be issued before the next step.
END	Motor identification is finished.

2.7.8 Commissioning the application

2.7.8.1 Commissioning the application

Commissioning the application

After the motor - Inverter combination has been commissioned using quick commissioning, the following parameters should be adapted and set according to the requirements of your specific application. As an example, the following points should be considered:

- Functional requirements of the inverter (for example, closed-loop process control with PID controller)
- Limit values
- Dynamic requirements
- Starting torques
- Load surge requirement
- Overload
- Diagnostics.

If the application includes a function, which is not covered by the quick commissioning, then the "Function" section in this manual or the parameter list should be consulted.

Note

In the factory setting, parameter changes are stored in the volatile memory of the inverter (RAM). To save the changes in the EEPROM one of the following methods can be used:

- Set P0014 = 1 all changes stored immediately in the EEPROM
- start data transfer from RAM to EEPROM via P0971 = 1 (when using OP) via  (with STARTER).

The duration of the data transfer depends on the number of changed parameters. In some cases it can last several minutes.

With the OP data transfer is displayed with "bUSY".

When using STARTER it is displayed via a progress bar. The successful transfer is displayed via a dialog box.

2.7.8.2 Flow chart - General settings

Commissioning the application - flow charts

The parameters designated with an "*" offer more setting possibilities than are listed here. Refer to the parameter list for additional setting possibilities.

General settings

Parameter	Description (Factory setting: bold)	Setting
P0003 = 3	User access level* 1: Standard: Allows access into most frequently used parameters. 2: Extended: Allows extended access e.g. to inverter I/O functions 3: Expert: For expert use only	
P0210 = ?	Supply voltage (enter the voltage in V) This parameter enters the real line supply voltage to which the Inverter is connected. Only necessary if P1254 = 0 (default: P1254 = 1).	
P0290 = 2	Inverter overload reaction This defines the response of the Inverter to an internal overtemperature. 0: Reduce output frequency 1: Trip (F0004) 2: Reduce pulse frequency and output frequency 3: Reduce pulse frequency then trip (F0004)	
P0335 = 0	Motor cooling (enter the motor cooling system) 0: Self-cooled using the shaft mounted fan attached to the motor 1: Force-cooled using the separately powered cooling fan 2: Self-cooled and internal fan 3: Force-cooled and internal fan	

2.7.8.3 Flow chart - Pulse encoder

Pulse Encoder

Parameter	Description (Factory setting: bold)	Setting
P0400 = 0 or P0400 = ?	Select encoder type * 0: Disabled (no encoder fitted) 2 or 12: Two quadrature encoder (two channels)	
P0408 = ?	Number of encoder pulses (Only if encoder is fitted) Enter the number of encoder pulses per revolution. The number of encoder pulses per revolution P0408 is limited by the maximum pulse frequency of the pulse encoder module ($f_{max} = 300 \text{ kHz}$)	

2.7.8.4 Flow chart - Temperature Sensor

Temperature Sensor

Parameter	Description (Factory setting: bold)	Setting
P0601 = 0 or P0601 = ?	Motor temperature sensor 0: No sensor (→ P0610) 1: PTC thermistor (→ P0604) 2: KTY84 (→ P0604)	
P0604 = ?	Threshold motor temperature Enter the warning threshold for motor overtemperature protection. The trip temperature (threshold) is where either the inverter is tripped or I_{max} is reduced (P0610) which is always 10 % above the warning threshold.	
P0610 = 2	Motor I2t temperature reaction Defines the reaction when the motor temperature reaches the warning threshold. 0: No reaction, only a warning 1: Warning and I_{max} reduced (this results in a reduced output frequency) 2: Warning and trip (F0011)	

Temperature calculation without sensor

In the vector control mode (P1300 = 20/21/22/23) Temperature calculations is possible without sensor. The following parameters have to be set.

Parameter	Description (Factory setting: bold)	Setting
P0621 = 1	Motor temperature identification after restart 0: No identification 1: Temperature identification only at first "motor on" after power cycle 2: Temperature identification at each motor on.	
P0622 =	Motor magnetizing time for temperature identification after stator resistance identification This parameter will be initialised with a value for one calculating cycle of the motor temperature. It depends on the identified rotor time constant. Due to accuracy reasons this calculation may be performed several times.	

2.7.8.5 Flow chart - Command source

Selection of command source

The available command sources depend on the used CU.

Default setting on the control unit used the command source is set per default to different values.

Parameter	Description (Factory setting: bold)	Setting
P0700 = 2/6	Selection of command source This selects the digital command source 0: Factory default setting 1: OP (keypad) 2: Terminal (P0701 ... P0709), factory setting for CU240S 4: USS on RS232 5: USS on RS485 (not available with CU240S DP and CU240S DP-F) 6: Fieldbus (P2050 ... P02091), factory setting for CU240S DP and CU240S DP-F, not available with CU240S	

Assigning digital input functions

Parameter	Description (Factory setting: bold)			Setting
P0701 = 1	Terminal 5: Digital Input 0 (DI0)	factory settings for CU240S	Possible values for P0701 to P0708: 0: Digital input disabled 1: ON/OFF1 2: ON reverse /OFF1 3: OFF2 - coast to standstill 4: OFF3 - quick ramp-down 9: Fault acknowledge 10: JOG right 11: JOG left 12: Reverse 13: MOP up (increase frequency) 14: MOP down (decrease frequency) 15: Fixed frequency selector bit0 16: Fixed frequency selector bit1 17: Fixed frequency selector bit2 18: Fixed frequency selector bit3 25: DC brake enable 27: Enable PID 2 29: External trip 2 33: Disable additional freq setpoint 99: Enable BICO parameterization	
P0702 = 12	Terminal 6: Digital Input 1 (DI1)			
P0703 = 9	Terminal 7: Digital Input 2 (DI2)			
P0704 = 15	Terminal 8: Digital Input 3 (DI3)			
P0705 = 16	Terminal 16: Digital Input 4 (DI4)			
P0706 = 17	Terminal 17: Digital Input 5 (DI5)			
P0707 = 0	Terminal 40: Digital Input 6 (DI6)	factory settings for CU240S	not available with CU240S DP-F	
P0708 = 0	Terminal 41: Digital Input 7 (DI7)			
P0709 = 0	Terminal 41: Digital Input 8 (DI8)			
P0724 = 3	Debounce time for digital inputs Defines the debounce time (filtering time) used for digital inputs. 0: No debounce time 1: 2.5 ms debounce time 2: 8.2 ms debounce time 3: 12.3 ms debounce time			
P9603 = 00	Terminal 62, 63: SLS via FD1A and FD1B		not availble with CU240S and CU240S DP	
P9603 = 01	Terminal 60, 61: SLS via FD0A and FD0B			
P9603 = 02	Terminal 62, 63: SS1 via FD1A and FD1B			
P9603 = 03	Terminal 60, 61: SS1 via FD0A and FD0B			
P9603 = 04	Terminal 62, 63: STO via FD1A and FD1B			
P9603 = 05	Terminal 60, 61: STO via FD0A and FD0B			

2.7.8.6 Flow chart - Digital output functions

Assigning digital output functions

Parameter	Description (Factory setting: bold)	Setting
P0731 = 52:3	BI: function of digital output 0 (DO0) , defines the source for digital output 0 Terminal 18: DO0, NC/Terminal 19: DO0, NO/Terminal 20: DO0, COM 52:3 Inverter fault active	
P0732 = 52:7	BI: function of digital output 1 , defines the source for digital output 1 Terminal 21: DO1, NO/Terminal 22: DO1, COM 52:7 Inverter warning active	
P0733 = 0:0	BI: function of digital output 2 , defines the source for digital output 2 Terminal 23: DO0, NC/Terminal 24: DO0, NO/Terminal 25: DO0, COM 0:0 Digital output disabled	
P0748	Invert digital outputs Bits 0, 1 and 2 can be used to invert the signals of digital outputs 0, 1 and 2	

2.7.8.7 Flow chart - Frequency setpoint

Frequency setpoint set

Parameter	Description (Factory setting: bold)	Setting
P1000 = ?	Selection of frequency setpoint 0: No main setpoint 1: MOP setpoint (P1031 ... P1040) 2: Analog setpoint (P0756 ... P0762), factory setting for CU240S 3: Fixed frequency (P1001 ... P1023) 6: Fieldbus (P2050 ... P2091), factory setting for CU240S DP and CU240S DP-F, not available with CU240S) 7: Analog setpoint 2 10: Additional setpoint (1 = MOP) + Main setpoint (0 = No main setpoint) 11: Additional setpoint (1 = MOP) + Main setpoint (1 = MOP) 12: Additional setpoint (1 = MOP) + Main setpoint (2 = Analog setpoint) ... 62: Additional setpoint (6 = Fieldbus) + Main setpoint (2 = Analog setpoint) 63: Additional setpoint (6 = Fieldbus) + Main setpoint (3 = Fixed frequency) ...	

Frequency setpoint via MOP (P1000 = 1)

Parameter	Description (Factory setting: bold)	Setting
P1031 = 0	Setpoint memory of the MOP The last motorized potentiometer setpoint, which was active before the OFF command or switching-off, can be saved. 0: MOP setpoint will not be stored 1: MOP setpoint will be stored in P1040	
P1032 = 1	Inhibit reverse direction of MOP 0: reverse direction is allowed 1: Reverse direction inhibited	
P1040 = 5	Setpoint of the MOP Defines the setpoint [Hz] of the motorized potentiometer (MOP).	

Frequency setpoint via analog input (AI) (P1000 = 2)

Parameter	Description (Factory setting: bold)	Setting
P0756 = 0	AI type Defines the type of the analog input and also enables analog input monitoring. 0: Unipolar voltage input (0 to +10 V) 1: Unipolar voltage input with monitoring (0 V ... +10 V) 2: Unipolar current input (0 mA ... 20 mA) 3: Unipolar current input with monitoring (0 mA ... 20 mA) 4: Bipolar voltage input (-10 V ... +10 V) NOTE: The following applies for P0756 ... P0760: Index 0: Analog input 0 (AI0), terminals 3 and 4 Index 1: Analog input 1 (AI1), terminals 10 and 11	
P0757 = 0	Value x1 of AI scaling [V/mA]	P0761 > 0 0 < P0758 < P0760 0 > P0758 > P0760 100 % ASPmax 4000 h P0761 P0758 P0757 P0759 10 V 20 mA x_{100%} V mA P0757 = P0761 ASPmin
P0758 = 0.0	Value y1 of AI scaling this parameter represents the value of x1 as a percentage of P2000 (reference frequency)	
P0759 = 10	Value x2 of AI scaling [V/mA]	
P0760 = 100	Value y2 of AI scaling This parameter represents the value of x2 as a percentage of P2000 (reference frequency)	

Frequency setpoint via fixed frequency (P1000 = 3)

Parameter	Description (Factory setting: bold)	Setting		
P1016 = 1	Fixed frequency mode, defines the selection method for fixed frequencies. 1: direct selection 2: binary coded	The fixed frequency can be selected via four digital inputs (default DI3 ... DI6). Fixed frequencies via direct selection (P1016 = 1): With the default settings additional combinations as follows are possible:		
P1001 = 0	Fixed frequency 1, (FF1) Value given in Hz.	Fixed Frequency selected via	FF- Par	FF [Hz]
P1002 = 5	Fixed frequency 2	DI3 (P1020 =722.3)	P1001 (default = 0 Hz)	0
P1003 = 10	Fixed frequency 3	DI4 (P1021 =722.4)	P1002 (default = 5 Hz)	5
P1004 = 15	Fixed frequency 4	DI5 (P1022 =722.5)	P1003 (default = 10 Hz)	10
P1005 = 20	Fixed frequency 5	DI6 (P1023 =722.6)	P1004 (default = 15 Hz)	15
P1006 = 25	Fixed frequency 6	DI3, DI4	P1001+P1002	5
P1007 = 30	Fixed frequency 7	DI3, DI5	P1001+P1003	10
P1008 = 35	Fixed frequency 8	DI3, DI6	P1001+P1004	15
P1009 = 40	Fixed frequency 9	DI4, DI5	P1002+P1003	15
P1010 = 45	Fixed frequency 10	DI5, DI6	P1003+P1004	25
P1011 = 50	Fixed frequency 11	DI3, DI4, DI5	P1001+P1002+P1003	15
P1012 = 55	Fixed frequency 12	DI3, DI4, DI6	P1001+P1002+P1004	20
P1013 = 60	Fixed frequency 13	DI3, DI5, DI6	P1001+P1003+P1004	25
P1014 = 65	Fixed frequency 14	DI3, DI4, DI5, DI6	P1001+P1002+P1003+P1004	30
P1015 = 65	Fixed frequency 15	Fixed frequencies via binary coded selection (P1016 = 2): With binary coded selection each frequency, set in one of the parameters P1002 ... P1015 can be directly selected.		
P1020 = 722.3	Fixed frequency selection - Bit 0 Selects DI3 for FF selection	Fixed Frequency selected via	FF- Par	FF-default setting [Hz]
P1021 = 722.4	Fixed frequency selection - Bit 1 Selects DI4 for FF selection	DI3 (P1020 =722.3)	P1001	0
P1022 = 722.5	Fixed frequency selection - Bit 2 Selects DI5 for FF selection	DI4 (P1021 =722.4)	P1002	5
P1023 = 722.6	Fixed frequency selection - Bit 3 Selects DI6 for F selection	DI5 (P1022 =722.5)	P1003	10
		DI6 (P1023 =722.6)	P1004	15
		DI3, DI4	P1005	20
		DI4, DI5	P1006	25
		DI5, DI6	P1007	30
		DI3, DI5	P1008	35
		DI4, DI6	P1009	40
		DI3, DI6	P1010	45
		DI3, DI4, DI5	P1011	50
		DI4, DI5, DI6	P1012	55
		DI3, DI5, DI6	P1013	60
		DI3, DI4, DI6	P1014	65
		DI3, DI4, DI5, DI6	P1015	65

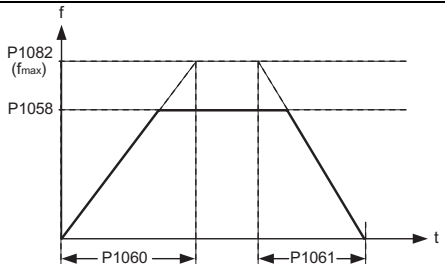
2.7.8.8 Flow chart - Analog outputs

Analog outputs

Parameter	Description (Factory setting: bold)	Setting
P0771 = 21	CI: Analog output Defines the function of the 0 mA ... 20 mA analog output 21: CO: actual frequency (scaled according to P2000) 24: CO: actual output frequency (scaled according to P2000) 25: CO: actual output voltage (scaled according to P2001) 26: CO: actual DC-link voltage (scaled according to P2001) 27: CO: Output current (scaled according to P2002) NOTE: The following applies for P0771 ... P0785: Index 0: analog output 0 (AO0), terminals 12 and 13 Index 1: analog output 1 (AO1), terminals 26 and 27	
P0775 = 0	Permit absolute value Decides if the absolute value of the analog output is used. If enabled, this parameter will take the absolute value of the value to be outputted. If the value was originally negative then the corresponding bit in r0785 is set.	
P0776 = 0	Type of analog output Scaling of r0774. 0: Current output 1: Voltage output NOTE: P0776 changes over the scaling of r0774 (0 mA ... 20 mA $\leftrightarrow$ 0 V ... 10 V). Scaling parameters P0778, P0780 and the deadband are always entered in 0 mA ... 20 mA. Analog output 0 can be switched to a voltage output with a range 0 ... 10 V. Analog output 1 is only a current output. When it is used as voltage output, it must be terminated using a 500 Ω resistor.	
P0777 = 0.0	Value x1 of the analog output scaling Defines x1 output characteristic in percentage. This parameter represents the lowest analog value as a percentage of P200x (depending on the setting of P0771).	
P0778 = 0	Value y1 of the analog output scaling This parameter represents the value of x1 in mA.	
P0779 = 100	Value x2 of the analog output scaling This defines x2 of the output characteristic in percentage. This parameter represents the highest analog value as a percentage of P200x (depending on the setting of P0771).	
P0780 = 20	Value y2 of the analog output scaling This parameter represents the value of x2 in mA.	
P0781 = 0	Width of analog output deadband This sets the width of the deadband in mA for the analog output.	

2.7.8.9 Flow chart - JOG frequency

JOG frequency

Parameter	Description (Factory setting: bold)	Setting
P1057 = 1	JOG Enable P1057 = 0 JOG-function disabled P1057 = 1 JOG-function enabled	
P1058 = 5	JOG frequency right Frequency in Hz when the motor is being jogged in the clockwise direction of rotation.	
P1059 = 5	JOG frequency left Frequency in Hz when the motor is being jogged in the counter-clockwise direction of rotation.	
P1060 = 45	JOG ramp-up time Ramp-up time in seconds from 0 to the maximum frequency (P1082). The JOG ramp-up is limited by P1058 or P1059.	
P1061 = 50	JOG ramp-down time Ramp-down time in seconds from the maximum frequency (P1082) to 0.	

2.7.8.10 Flow chart - Additional Setpoints

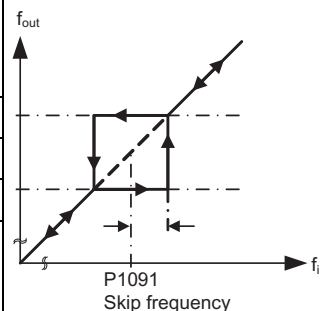
Additional Setpoints

Parameter	Description (Factory setting: bold)	Setting
P1074 = 1.0	BI: disable additional setpoint	
P1075 = 775	CI: additional setpoint Defines the source of the additional setpoint which is added to the main setpoint. Common settings: 755: Analog input setpoint 1024: Fixed frequency setpoint 1050: MOP setpoint	
P1076 = 1.0	CI: additional setpoint scaling Defines the source to scale the additional setpoint. Common settings: 1: Scaling of 1.0 (100 %) 755: Analog input setpoint 1024: Fixed frequency setpoint 1050: MOP setpoint	

2.7.8.11 Flow chart - Skip Frequency

Skip Frequency

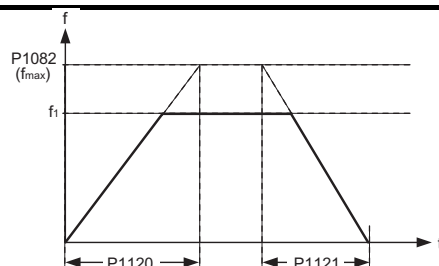
Parameter	Description (Factory setting: bold)	Setting
P1091 = 7.5	Skip frequency 1 (entered in Hz) Avoids mechanical resonance effects and suppresses (skips) frequencies in the range around the skip frequency $\pm$ P1101 (skip frequency bandwidth).	
P1092 = 0.0	Skip frequency 2	
P1093 = 0.0	Skip frequency 3	
P1094 = 0.0	Skip frequency 4	
P1101 = 1.0	Skip frequency bandwidth (entered in Hz)	



2.7.8.12 Flow chart - Ramp times, rounding

Ramp times

Parameter	Description (Factory setting: bold)	Setting
P1120 = 8	Ramp-up time Enter the acceleration time in seconds.	
P1121 = 5	Ramp-down time Enter the deceleration time in seconds.	



Rounding

Parameter	Description (Factory setting: bold)	Setting
P1130 = 5.0	Ramp-up initial rounding time (in seconds)	The rounding times are recommended, as abrupt responses can be avoided therefore reducing stress and damage to the mechanical system. The ramp-up and ramp-down times are extended by the component of the rounding ramps.
P1131 = 5.0	Ramp-up final rounding time (in seconds)	
P1132 = 5.0	Ramp-down initial rounding time (in seconds)	
P1133 = 5.0	Ramp-down final rounding time (in seconds)	
P1134 = 0	Rounding type 0: continuous smoothing (jerk-free) 1: Discontinuous smoothing NOTE: for discontinuous rounding (P1134 = 1), after the setpoint is reduced or an OFF1 command, the final rounding at ramp-up (P1131) and the initial rounding at ramp-down (P1132) are not executed.	

2.7.8.13 Flow chart - Finishing the application setting

Parameters to set before finishing the application setting

The following parameters should be configured for each application

Parameter	Description (Factory setting: bold)	Setting
P1800 = 4	Pulse frequency (kHz) The pulse frequency can be changed in 2 kHz steps. The range extends from 2 kHz up to 16 kHz. The complete inverter output current at 50 °C is reached with 4 kHz. The maximum output frequency is limited by the pulse frequency. Operation up to 133 Hz is possible with a pulse frequency of 2 kHz. If a higher output frequency is required, then the pulse frequency should also be increased (10 kHz pulse frequency - maximum output frequency of 650 Hz) If low-noise operation is not required, then the inverter losses and the high-frequency disturbances emitted by the inverter can be reduced by selecting lower pulse frequencies.	
P2000 = 50	Reference frequency (Hz) The reference frequency in Hertz corresponds to a value of 100 %. This setting should be changed if a maximum frequency of higher than 50 Hz is required. NOTE: This scaling acts on the maximum frequency of the analog setpoints, fixed frequencies and motorized potentiometer normalization operations are referred to 100 %.	
P2001 = 1000	Reference voltage (V) The reference voltage in Volts (output voltage) corresponds to a value of 100 %. NOTE: This setting should only be changed if it is necessary to output the voltage with another scaling.	
P2002 = ?	Reference current (A) The reference current in Amperes (output current) corresponds to a value of 100 %. Factory setting is 200 % of the rated motor current (P0305). NOTE: This setting should only be changed if it is necessary to output the current with another scaling.	
P2003 = ?	Reference torque (Nm) The reference torque in Newton-metres corresponds to a value of 100 %. Factory setting is 200 % of the rated motor torque, determined from the motor data, for a constant motor torque. NOTE: This setting should only be changed if it is necessary to output the torque with another scaling.	
P2004 = ?	Reference power (kW or hp) The reference power in kW or hp corresponds to a value of 100 %. Factory setting is 200 % of the rated motor power at constant motor torque. This setting should only be changed if it is necessary to output the power with another scaling.	
bUSY	Once the save command is given, "bUSY" will be displayed	
END	When the save is completed, the display will return to normal and parameterization is complete.	

Finishing the application setting

Parameter	Description (Factory setting: bold)	Setting
P0971 = 1	Transfer data from RAM to EEPROM 0: Disabled 1: Start data transfer, RAM → EEPROM All of the parameter changes are transferred from the RAM into the EEPROM which means that they are saved in a non-volatile state within the Inverter (data is not lost when the power fails). While the transfer is active, "bUSY" will be displayed on the OP. Once the transfer is completed P0970 will be set internally to "0" and the "P0970" will be displayed.	

2.7.9 Series Commissioning

2.7.9.1 Series commissioning

Overview

Series commissioning means the possibility to transfer the parameter set from one inverter into a number of other inverters which allows fast commissioning for identical applications (for example series machines or group inverters).

The series commissioning is divided into the following steps:

- create a proper parameter set
- upload this parameter set
- download of the uploaded parameter set into the new inverter

To perform series commissioning an appropriate parameter set must be available. This parameter set can be created by parameterizing an Inverter via OP or STARTER.



Caution

Parameter download between different types of control units and of different firmware versions is not recommended.

Basically, it is possible to download parameter sets off different CU types, however, as the parameter sets might differ, the user is fully responsible for the consistency of the downloaded parameter set.

Therefore, the customer has to confirm his responsibility in case of an automatic download by acknowledging F0395.

Once an inverter with an appropriate parameter set is available, the parameter set can be uploaded and in the next step downloaded into the new inverter via OP, STARTER or MMC. The various interfaces are shown in the figure below.

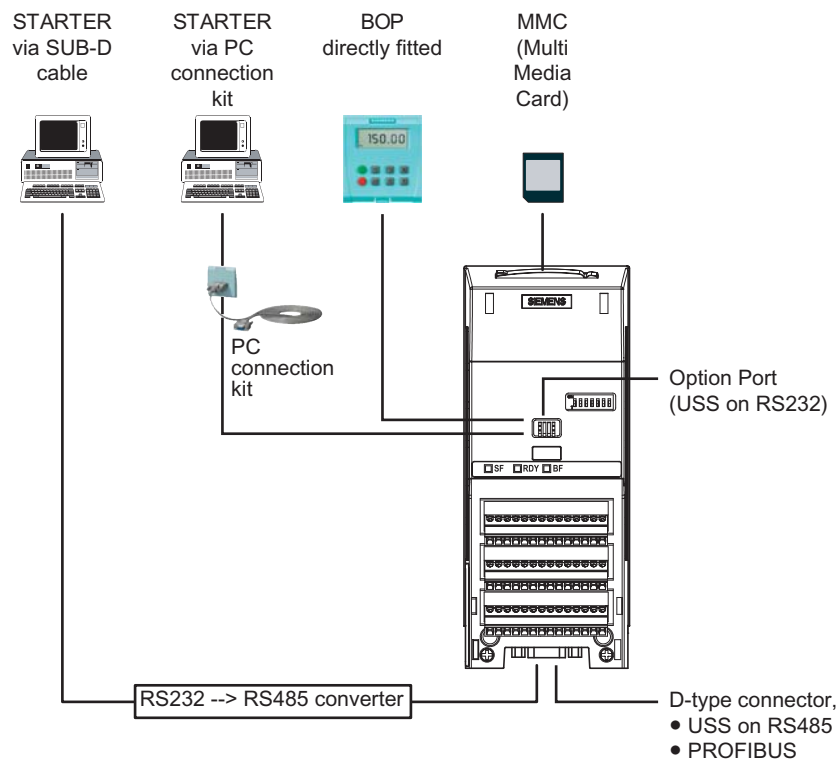


Figure 2-9 Series commissioning interfaces



Warning

For series commissioning, all of the communication interfaces as well as also the digital and analog interfaces are re-initialized. This results in a brief communications failure or causes the digital outputs to switch.

Potentially hazardous loads must be carefully secured before starting a series commissioning.

Potentially hazardous loads can be secured as follows before starting series commissioning:

- Lower the load to the floor, or
- Clamp the load using the motor holding brake.

Note**Manual and automatic download**

With a manual download all necessary parameters excluding the safety parameters (only with fail-safe CUs) are downloaded into the inverter. A manual download can be triggered by the customer as described in the following.

With an automatic download even the safety parameters are downloaded into the inverter. An automatic download can only be performed with an MMC at Start-up or after a swapping an inverter component (CU or PM), details are described in the following sections and in the chapter "Operation" of this manual.

2.7.9.2 Series commissioning with the OP

Upload and download a parameter set with an OP

A single parameter set can be uploaded from an inverter and then downloaded into another inverter.

Note

The following important restrictions should be considered when performing upload and download:

- Only the parameter set stored in the EEPROM of the inverter is uploaded to the OP.
 - Safety parameter cannot be uploaded to the OP.
 - Once the upload or download procedure has started, it should not be interrupted.
 - It is possible to upload data from inverters of different power and voltage ratings.
 - During download, if data are not compatible with the inverter, the default values for the affected parameter will be written to the inverter.
 - During the up or download the "RDY" LED (green) is flashing. After finishing that process successfully the "RDY" LED is on.
 - During the upload process any data already held by the OP is overwritten.
 - If the download fails, the inverter will not function correctly and the "SF" LED (red) is on.
 - Possible fault messages in case of download failure with OP
F0055, F0056, F0057 or F0058
 - Possible fault messages in case of download failure with MMC
F061, F0062 or F0063
-

Notice

After upload and download of parameters between differing Control Units, parameter settings must be checked.

To copy a parameter set from one inverter to another, the following procedure should be performed.

Upload a parameter set with an OP

Prerequisites

- An inverter with an appropriate parameter set is available (upload inverter)
- Supply voltage is active for the upload inverter
- The upload inverter is in "Ready State".

Parameter	Action / Description (Factory setting: bold)	Setting
	Fit the OP to the Inverter - for the parameter set to be uploaded, perform the following steps:	
P0003 = 3	User access level* 1: Standard: Allows access into most frequently used parameters 2: Extended: Allows extended access e.g. to inverter I/O functions 3: Expert: For expert use only	
P0010 = 30	Commissioning parameter* 0: Ready 1: Quick commissioning 2: Inverter 30: Factory setting, parameter transfer 95: Commissioning the fail-safe functions (CUs with Safety-Integrated functions only)	
P0802 = 1	Transfer data from EEPROM 0: Disabled 1: Start OP transfer 2: Start MMC Transfer While the upload is active "bUSY" will be displayed on the OP and the inverter will not react to any commands.	
	If the upload has been completed successfully, P0010 and P0802 will be set to 0 and the OP display will return to normal. If the upload has failed, F00055 (failure while saving parameter on OP) or F00057 (OP fault) will be displayed. In this case attempt another download or perform a factory reset.	
	After a successful upload disconnect the OP from the upload inverter.	

Download a parameter set with an OP

Prerequisites

- Supply voltage is active for the download inverter
- The download inverter is in "Ready State".

Parameter	Action / Description (Factory setting: bold)	Setting
	Fit the OP to the inverter and perform the download according the flow chart.	
P0003 = 3	User access level* 1: Standard: Allows access to the most frequently used parameters 2: Extended: Allows extended access e.g. to inverter I/O functions	

Parameter	Action / Description (Factory setting: bold)	Setting
	3: Expert: For expert use only	
P0010 = 30	Commissioning parameter* 0: Ready 1: Quick commissioning 2: Inverter 30: Factory setting, parameter transfer 95: Safety commissioning (for Safety-Integrated CUs only)	
P0803 = 1	Transfer data to EEPROM 0: Disabled 1: Start OP transfer 2: Start MMC Transfer While the download is active "bUSY" will be displayed on the OP and the inverter will not react to any commands.	
	If the download has been completed successfully, P0010 and P0803 will be set to 0 and the OP display will return to normal. If the download has failed, F00055 (failure while saving parameter to EEPROM), F00057 (OP fault) or F00058 (OP contents incompatible) will be displayed. In this case attempt another download or perform a factory reset to allow the inverter to return to a known state.	
	After a successful download the OP can be removed and inserted into another inverter for download. Then perform the download steps again until the series commissioning has been completed for all inverters.	

2.7.9.3 Series commissioning with STARTER

Upload a parameter set with STARTER

Prerequisites

- An inverter with an appropriate parameter set is available (upload inverter)
- STARTER is installed on the PC used for series commissioning
- Supply voltage is active for the upload inverter
- The upload inverter is in "Ready State".

Connect the STARTER PC via the Option Port (USS on RS232, peer to peer) to the upload inverter (PC connection Kit required), press the online button  and perform the upload by activating the button .

Note

Upload with STARTER to MMC

If you want to upload a parameter set with STARTER to an MMC, P0010, P0802 must be set via the expert list.

Download a parameter set with STARTER

Prerequisites

- Supply voltage is active for the download inverter
- The download inverter is in "Ready State".

Connect the STARTER PC via the Option Port (USS on RS232, peer to peer) to the download inverter (PC connection Kit required), press the online button  and perform the download by activating the button . The data set must be saved in the EEPROM.

Note

If you want to perform an manual download of a parameter set with STARTER from an MMC, P0010, P0803 and P0804 must be set via the expert list.

2.7.9.4 Inserting and removing the MMC

Inserting the MMC

To insert an MMC into the Control Unit of the inverter, the process shown in the figure below should be performed.

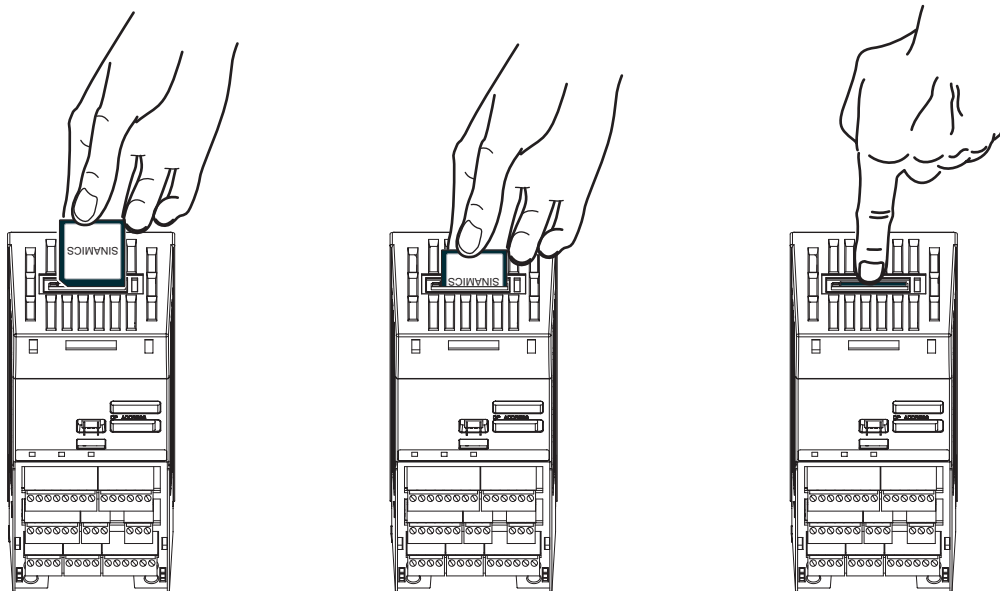


Figure 2-10 Installing the MultiMedia Card (MMC)

Removing the MMC

To remove the MMC from the Control Unit, the following procedure should be performed:

6. Using a thin-bladed screwdriver, push down the release-catch on the MMC housing.
7. Grasp the MMC gently and pull upwards.

This procedure is shown in the figure below.

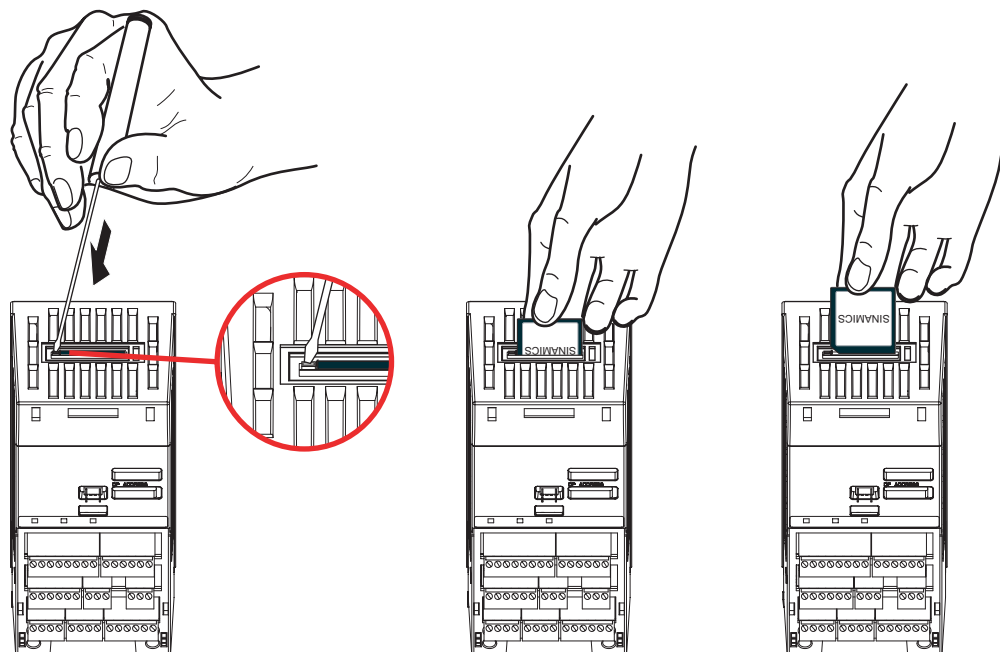


Figure 2-11 Removing the MMC from the Control Unit

2.7.9.5 Series commissioning with MMC

Upload and download a parameter set with an MMC

A parameter set can be uploaded from an inverter and then downloaded into another inverter. The following important restrictions must be considered when using the copying procedure:

- An inverter with an appropriate parameter set is available (upload inverter)
- The upload inverter can be accessed via OP, STARTER or PROFIBUS
- An MMC Type 6SL3254-0AM00-0AA0 is available.

Upload a parameter set with an MMC

Prerequisites

To perform a series commissioning with the MMC the following conditions must be fulfilled:

- Supply voltage is active for the upload inverter
- The upload inverter is in "Ready State".

Parameter	Action/Description (Factory setting: bold)	Setting
	Insert the MMC to the inverter - for the parameter set to be uploaded, perform the following steps:	
P0010 = 30	Commissioning parameter* 0: Ready 1: Quick commissioning 2: Inverter 30: Factory setting 95: Commissioning the fail-safe functions (CUs with Safety-Integrated functions only)	
P0804 = ?	Select Clone file 0: clone00.bin ... 99: clone99.bin	
P0802 = 2	Transfer data from EEPROM 0: Disabled 1: Start OP Transfer 2: Start MMC Transfer	
	If the upload has been completed successfully, P0010 and P0802 will be set to 0 and the "RDY" LED is on. If the upload has failed, F0061 (MMC-PS not fitted) will be displayed, LED "SF" (red) is on. In this case insert an MMC and attempt another upload.	
	After a successful upload remove the MMC from the upload inverter.	

Manual Download of a parameter set with an MMC

Note

The following important restrictions should be considered when using the download procedure:

- During the download the inverter will not react to any commands.
- Once the download procedure has started, it cannot be interrupted.
- During download, if the data is not compatible with the inverter, the default values for those parameters will be written into the inverter memory.
- If the download fails, the inverter will not function correctly.

Prerequisites

- Supply voltage is active for the download inverter
- The download inverter is in "Ready State".

Parameter	Action/Description (Factory setting: bold)	Setting
	Insert the MMC to the download inverter and perform the manual download according the flow chart.	
P0010 = 30	Commissioning parameter* 0: Ready 1: Quick commissioning 2: Inverter 30: Factory setting 95: Commissioning the fail-safe functions (CUs with Safety-Integrated functions only)	
P0804 = ?	Select Clone file (for download) 0: clone00.bin ... 99: clone99.bin	
P0803 = 2	Transfer data to EEPROM 0: Disabled 1: Start OP Transfer 2: Start MMC Transfer	
	If the download has been completed successfully, P0010 and P0803 will be set to 0 and the "RDY" LED is on. If the upload has failed, F0061 (MMC-PS not fitted) or F0062 (MMC-PS contents invalid) resp. F0063 (MMC-PS contents incompatible) will be displayed, LED "SF" (red) is on. In this case insert a proper MMC and attempt another download or perform a factory reset.	
	After a successful manually download remove the MMC from inverter and insert it to the next download inverter. Then perform the download steps again until the series commissioning has been completed for all inverters.	

Automatic Download

The automatic download at start-up is controlled via P8458. With the automatic download all necessary parameters including the parameters regarding fail-safe functions are downloaded into the inverter.

Note**MMC for "automatic download"**

For an automatic download always the file clone00.bin will be used.

The user has to take care, that clone00.bin (saved as "clone00.bin" with STARTER on PC or via setting P0804 = 00 with the OP) is available on the MMC, used for an automatic parameter download at start-up. Otherwise automatic download will not be processed.

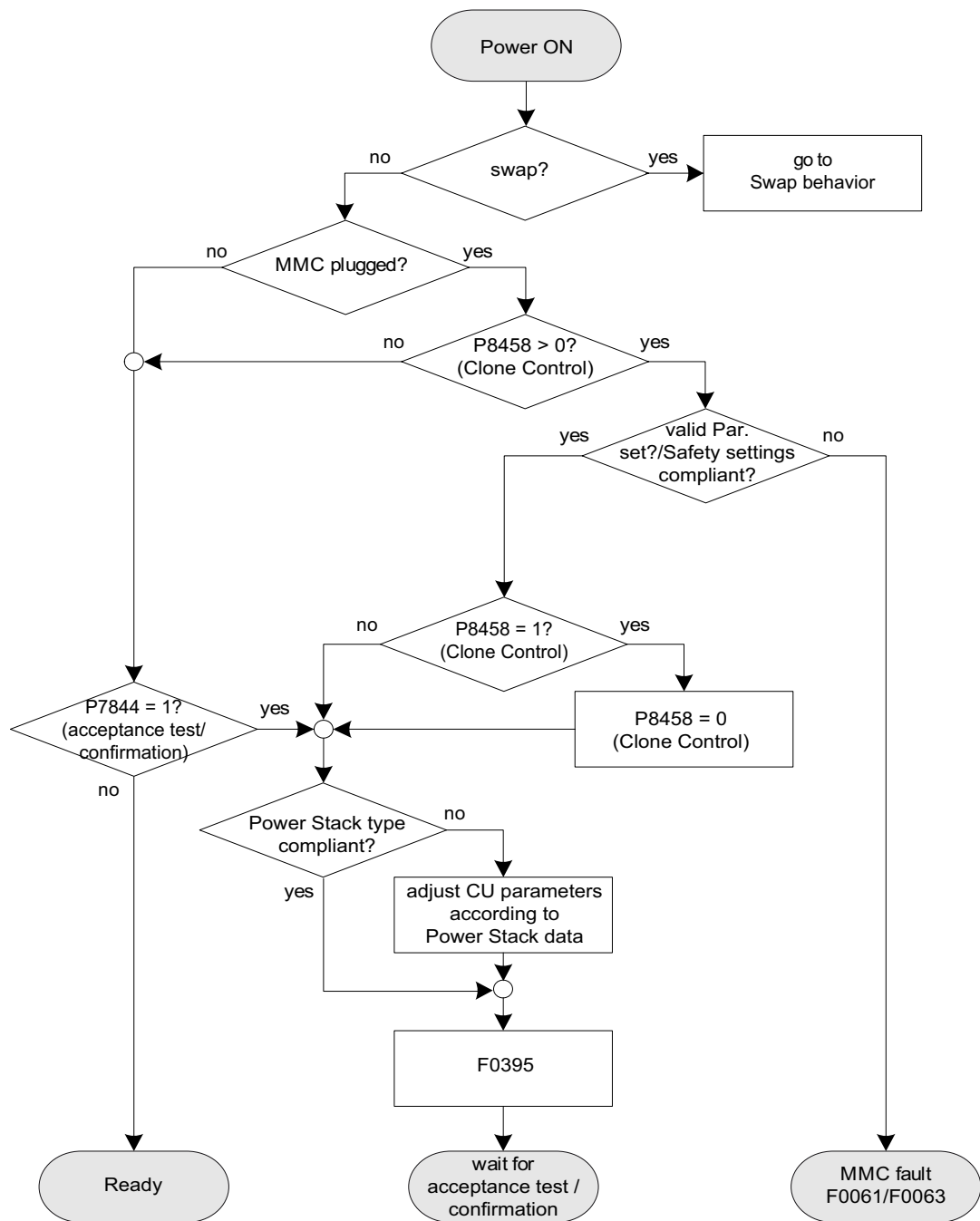


Figure 2-12 Automatic download - overview

The possible settings for P8458 and their functions are given below.

- P8458 = 0: Automatic parameter download from the MMC is inhibited.
- P8458 = 1: Automatic parameter download from the MMC only at the first start-up of the CU (default setting).
- P8458 = 2: Automatic parameter download from the MMC after each start-up of the control unit.

Successful automatic download

After a successful automatic download, F0395 will be displayed.

- In case of a standard CU a confirmation is necessary.
- In the case of CUs with safety integrated functions, an acceptance test must be performed.

Confirmation

On standard CUs the current parameter set needs to be checked and confirmed by clearing F0395. It can be cleared via:

- Digital input or PLC signal (depends on the settings of P0700)
- setting P7844 = 0.



Warning

The user is responsible for ensuring that the parameters held in the CU are the correct parameters for their application.

Acceptance test

On CUs with integrated fail-safe functions it is necessary to do an acceptance test (refer to the "Safety-Integrated functions" section in this manual). To clear F0395 on CUs with integrated fail-safe functions the following procedure has to be followed:

- P0010 = 95
- P9761 = fail-safe password
- P7844 = 0

Automatic download fault

If the automatic download process fails, the CU will return to the parameter set previously held in the EEPROM and the following fault codes are generated:

Table 2-17 Automatic download fault codes

Fault code	Description
F0061	Automatic download of parameters was not successful.
F0063	Automatic download of parameters was not successful (e.g. wrong CU).

In this case check, whether the MMC is defective or a parameter set clone00.bin is available or the parameter set is valid.

2.7.10 Reset parameters to factory settings

Overview

With a factory setting a defined initial state of all of the inverter parameters can be realized.

You can re-establish the initial state by carrying-out a factory via p0970. The factory setting values are designated as "Def" in the parameter list.

After a factory reset, the inverters have the following basic settings:

CUs with RS485 interface (no PROFIBUS interface)

- Control using the digital inputs
 - ON/OFF using DI0
 - Direction of rotation reversal using DI1
 - Fault acknowledgement using DI2.
- Setpoint input using analog input 1
- Signal output using the digital outputs
 - Fault active using DO0
 - Warning active using DO1.
- Actual frequency using the analog output
- The basic V/f characteristic is the control mode (P1300 = 0)
- Asynchronous motor (P0300 = 1).

CUs with PROFIBUS interface

- For the PROFIBUS variants the command source and setpoint source will be set to PROFIBUS communication.
- The basic V/f characteristic is the control mode (P1300 = 0)
- Asynchronous motor (P0300 = 1).

Note

When resetting the parameters to the factory setting, the communications memory is re-initialized. This means that communications are interrupted for the time it takes to perform the reset.

**Warning****Safety-Integrated parameters**

When using CUs without safety-integrated functions, only the factory reset with P0970 = 1 must be taken into account.

When using CUs with safety integrated functions two reset methods are available:

- P0970 = 1 resets only non fail-safe function relating parameters (application parameters).
If a factory reset with P0970 = 1 is performed on a Safety-Integrated control unit all application parameters will be reset, previous parameters settings regarding fail-safe functions remain unchanged. This means, no acceptance test has to be performed.
- P0970 = 10 (password protected) resets only fail-safe function relating parameters
If parameters regarding fail-safe functions must be changed, an acceptance test has to be performed.

2.7.11 Reset parameters to factory settings - Flow chart

Reset to the factory setting

Parameter or action	Description
P0003 = 1	User access level* 1: Standard: Allows access into most frequently used parameters.
P0004 = 0	Parameter filter 0: All parameters
P0010 = 30	Commissioning parameter* 30: Factory setting
P0970 = 1	Factory reset* 1: Parameter reset to the default values
BUSY (on OP) Progress bar (STARTER)	The inverter carries-out a parameter reset (duration, approx. 10 s) and then automatically exits the reset menu and sets P0970 = 0: Disabled P0010 = 0: Ready

Note

The following parameters will not be changed with a factory reset:

P0014 Store mode

P0100 Europe / North America

P0201 power stack code number

Data depending on actual Power module

2.8 Encoder Commissioning

2.8.1 Commissioning the Encoder Interface

Commissioning the Encoder Interface



Warning

Before installing and commissioning, please read these safety instructions and warning carefully and all the warning labels attached to the equipment. Make sure that the warning labels are kept in a legible condition and replace missing or damaged labels.

This equipment contains dangerous voltages and controls potentially dangerous rotating mechanical parts.

Non-Compliance with Warnings or failure to follow the instructions contained in this manual can result in loss of life, severe personal injury or serious damage to property.

Only suitably qualified personnel should work on this equipment, and only after becoming familiar with all safety notices and maintenance procedures contained in this manual.

The successful and safe operation of this equipment is dependent upon its proper handling, storage, installation, operation and maintenance.

National safety regulations are also applicable.

The actions required to commission the encoder depend upon the type (HTL or TTL) that is connected to the encoder interface. The following table gives an overview about the single steps depending on the type of encoder.

Encoder commissioning

To commission the Encoder, the following procedure should be performed:

Table 2-18 Commissioning the Encoder

Step	Description	TTL	HTL
1.	Ensure the Inverter is switched off.	X	X
2.	Connect the Channel A wire from the encoder to terminal 70 (ENC AP) on the Control Unit.	X	X
3.	Connect the Channel A inverted wire from the encoder to terminal 71 (ENC AN) on the Control Unit.	X	X
4.	Connect the Channel B wire from the encoder to terminal 72 (ENC BP) on the Control Unit.	X	X
5.	Connect the Channel B inverted wire from the encoder to terminal 73 (ENC BN) on the Control Unit.	X	X
6.	Connect the Channel Z wire from the encoder to terminal 74 (ENC ZP) on the Control Unit.	X	X
7.	Connect the Channel Z inverted wire from the encoder to terminal 75 (ENC ZN) on the Control Unit.	X	X
8.	Connect the positive power cable to terminal 33 (ENC+ SUPPLY) on the Control Unit.	X	X
9.	Connect the negative power cable to terminal 28 (U0V) on the Control Unit.	X	X
10.	Switch the general I/O DIP-switch 4 (5 V) to the ON position (TTL)	X	
11.	Switch the general I/O DIP-switch 3 (24 V) to the ON position. (HTL)		X
12.	Check that all the connections have been made correctly and the DIP-switch is in the correct position.	X	X
13.	Switch the inverter ON.	X	X
14.	The Encoder interface now requires to be parameterized. A flow chart that shows the required parameters is given in the following section.	X	X

Note

The cable from the encoder to the Encoder Module should be one complete length.

TTL-encoder specific

If the encoder type is a TTL differential and a long cable length is required (>50 m), DIP switches 5, 6, and 7 may be set to ON.

If the encoder type is a TTL single-ended encoder, there will be a three wires for the 'A', 'B' and 'Z' Channels.

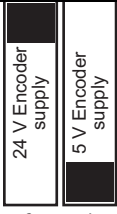
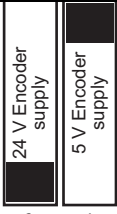
HTL-encoder specific

The terminating impedance which is selected using the DIP-switches must not be used in conjunction with an HTL encoder.

The encoder voltage is using the general I/O DIP switches 3 and 4.

The following table shows the possible settings:

Table 2-19 Encoder voltage settings

	On									
	OFF									
										
Encoder supply voltage	0 V		24 V		5 V		24 V			
Encoder type	No encoder		HTL encoder		TTL encoder		HTL encoder			

**Warning**

DIP switches 3 and 4 in ON position provide a supply voltage of 24 V to the encoder. Therefore it is not allowed to connect a TTL encoder to the inverter if both DIP switches, 3 and 4 are in ON position.

2.8.2 Parameterizing the Encoder Interface

Encoder parameterization

To enable the Encoder to function correctly with the inverter, the parameters in the table below, must be modified.

Table 2-20 Encoder parameters

Parameter	Name	Values	
r0061	Rotor speed	Indicates the speed of the rotor. Used to check that the system is working correctly.	
r0090	Rotor angle	Indicates the current angle of the rotor. This function is not available on single input channel encoders.	
P0400[3]	Encoder type	0: No encoder 2 or 12: Quadrature encoder (channel A + B) – the term "quadrature" means two periodic functions separated by a quarter cycle or 90 degrees	
r0403	Status word of encoder	Displays status word of encoder in bit format:	
	Bit 00 - Encoder module active	0	No
		1	Yes
	Bit 01 - Encoder error	0	No
		1	Yes
	Bit 02 - Signal OK	0	No

Parameter	Name	Values
	Bit 03 - Encoder low speed loss	1 Yes
		0 No
	Bit 05 - Single edge measurement	1 Yes
		0 No
P0405	Encoder pulse types	Enables selection of various pulse types. Only bits 04 and 05 are used for the SINAMICS G120. See parameter list.
P0408[3]	Pulses per revolution	Specifies the number of encoder pulses per revolution
P0491[3]	Reaction on speed signal loss	Selects reaction on loss of speed signal. Settings: 0: Do not change to SLVC 1: Change to SLVC
P0492[3]	Allowed speed difference	Used for high speed encoder loss detection. Selects the allowable difference in calculated speed signals between samples before it is considered to have lost the speed signal feedback. (Default = Calculated from inertia, range from 0 to 100.00) Dependency: Parameter is updated when P0345 Motor start-up time is changed or when a speed loop optimization is performed (P1960 = 1). There is a fixed delay of 40 mS before acting upon loss of encoder at high speeds. Caution: When allowed speed difference is set to 0, then both high speed and low speed encoder loss detection is disabled, encoder loss will not be detected. If encoder loss detection is disabled and encoder loss occurs, then operation of the motor may become unstable.
P0493[3]	Speed difference	Allowed difference between encoder and observer.
P0494[3]	Delay speed loss reaction	Used for low speed encoder loss detection. If the motor shaft speed is less than the value in P0492 then encoder loss is detected using a low speed encoder loss detection algorithm. This parameter selects the delay between loss of encoder at low speed and reaction to the encoder loss. (Default = Calculated from inertia, Range from 0 to 64.000s). Dependency: This parameter is updated when P0345 Motor start-up time is changed or when a speed-loop optimization is performed (P1960 = 1). Caution: When this delay is set to 0, then low speed encoder loss detection is disabled and low speed encoder loss cannot be detected (high speed encoder loss detection will still operate if P0492 > 0). If low speed encoder loss detection is disabled and encoder should be lost at low speed, then operation of motor may become unstable.
P1300	Control Mode	21: Closed loop speed control 23: Closed loop torque control



Caution

Once the correct parameters values have been entered, it is recommended to operate the inverter in V/f mode (P1300 = 0) before speed/torque control with the encoder feedback is used and check that it functions correctly.

The user must observe the motor shaft to check the direction of rotation.

The direction of rotation must be checked against the value displayed in r0061.

If the direction of rotation does not match, then the output phases of the inverter or the encoder channels have to be transposed to prevent unstable operation of the inverter in closed-loop control mode.

Setting P1820 to 1 can be used to reverse the motor rotation without transposing the output phases.

Ramp times (P1120 and 1121 cause F90 (encoder feedback loss).

Note

The encoder resolution (pulses per revolution) which may be entered will be limited by the maximum pulse frequency of the encoder option port ($f_{\max} = 300 \text{ kHz}$).

The following equation calculates the encoder frequency depending on the encoder resolution and the rotational speed (rpm). The encoder frequency has to be less than the maximum pulse frequency:

$$f_{\max} > f = \frac{\text{Pulses per revolution} \times \text{r.p.m.} \left[\frac{1}{\text{min}} \right]}{60}$$

Example: An Encoder may have 1024 pulses per revolution. It rotates at $n_N = 2850 \text{ min}^{-1}$. This delivers $f = 48,64 \text{ kHz} < f_{\max} = 300 \text{ kHz}$, therefore the Encoder can be used with the Encoder Interface.

P0492 is measured in Hz per milliseconds. If the inverter output frequency varies faster than the maximum allowable change in output frequency, it will trip with a fault condition F0090.

2.8.3 Encoder fault codes

Encoder fault codes

The Encoder Interface has only one fault code, – F0090. This condition occurs when the allowed frequency rate of change, set in P0492[3] is exceeded or when low speed encoder loss is detected.

Note

The reason for the encoder loss will be given in the level 3 parameter P0949:

P0949 = 1 means encoder loss of channel A or channel B or channel A and channel B at high speed (shaft speed > P0492)

P0949 = 2 means encoder loss of channel A or channel A and channel B at low speed (shaft < P0492)

P0949 = 7 means excessive flux variance which may cause motor instability - possible due to encoder loss.

Remedial action on fault condition

Should the encoder give a fault message F0090 the following remedial action should be performed:

8. Check that an encoder is fitted. If the encoder is not fitted, set P0400 = 0 and select SLVC mode (P1300 = 20 or 22).
9. Check the connections between the encoder and the inverter.
10. Check the encoder is not faulty (select P1300 = 0 and run at a fixed speed then check the encoder feedback signal using r0061). Check for correct magnitude and direction of speed.
11. Increase the encoder loss threshold in P0492.
12. Increase encoder low speed loss detection delay in P0494.

Operation

3.1 General Operation behaviour

Overview

The operation and start-up behavior depends on the settings during commissioning of the inverter.

As specific operation features the "Normal start-up behavior" and "Swap behavior" as well as "up and download of parameter sets" are described in this section.

3.2 Start-up Behavior

Overview

When starting-up the inverter checks, whether an MMC is plugged in or not.

If it is plugged and no swap has been taken place the start-up runs according the "Normal start-up behavior". If a component (CU or PM) has been replaced, this is called a swap and the start-up will be performed according the "Swap behavior" of the inverter.

3.2.1 Normal Start-up behavior of the Inverter

Normal start-up behavior of the inverter

A normal start-up is a start-up after a power-cycle or a black-out. It can be performed with or without MMC.

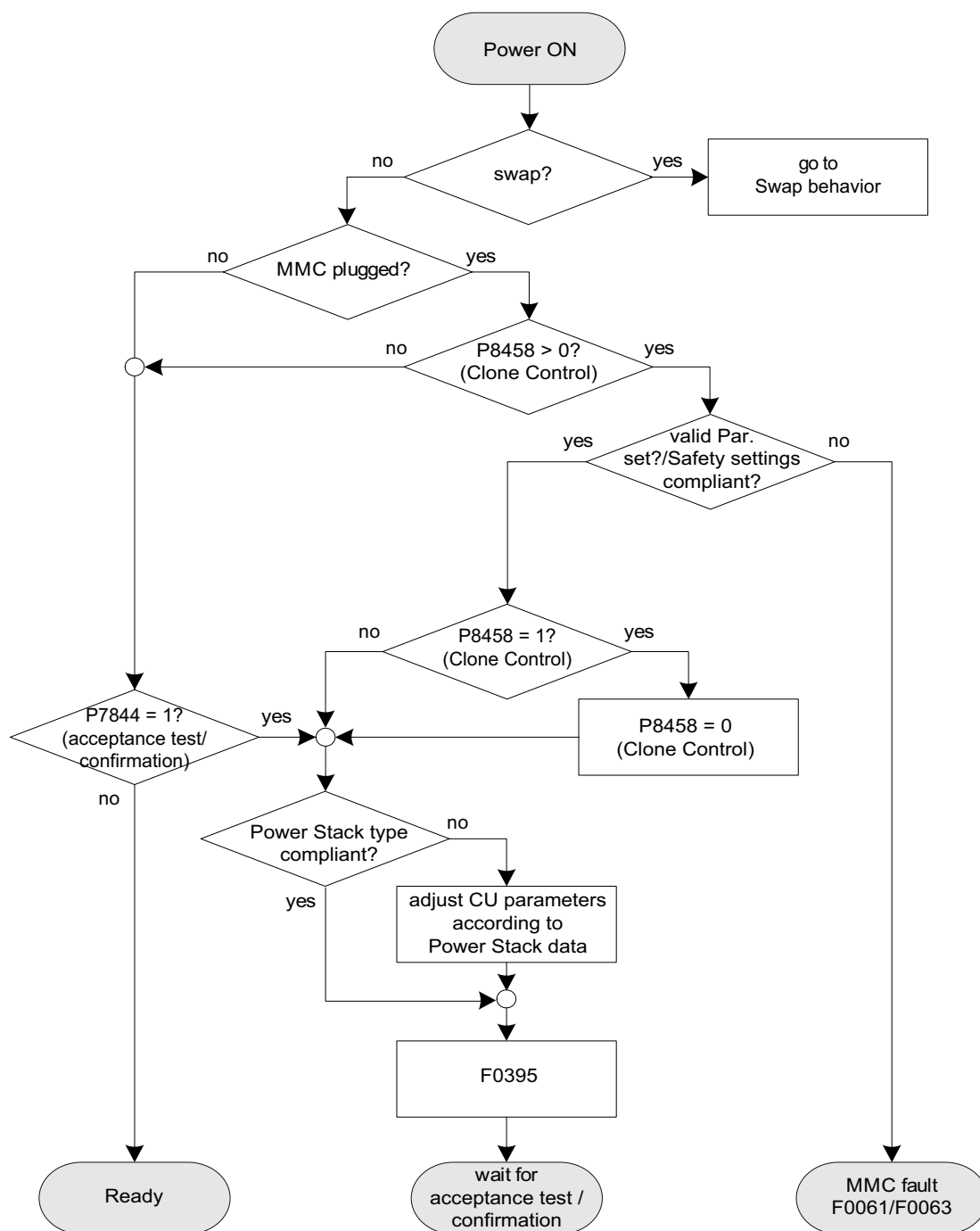


Figure 3-1 Normal start-up behavior

Normal start-up behavior without MMC

After a power-cycle or a black-out the inverter reads the parameters from EEPROM to RAM.

Normal start-up behavior with MMC

The CUs have been designed to detect automatically whether an MMC is present in the CU. The interaction between the CU and the MMC is controlled using parameter P8458.

The possible settings for P8458 and their functions are given below.

P8458 = 0: No automatic parameter download from the MMC.

P8458 = 1: Automatic parameter download from the MMC (if present) only at the first start-up of the CU (default setting).

P8458 = 2: Automatic parameter download from the MMC (if present) after each start-up of the control unit.

On completion of the automatic download parameter P8458 will be set to 0 (if it was 1 before download) to prohibit any further automatic download parameters. In this case the MMC can be withdrawn after an automatic parameter download.

The setting P8458 = 1 is only meaningful for new CUs. It enables the user to commission the inverter by an automatic parameter download from a MMC.

If parameter P8458 is set to 1 or 2 and no MMC is present the inverter starts with the parameters of the EEPROM without alarm or fault message.

Note

MMC for "automatic download"

For an automatic download always the file clone00.bin will be used.

The user has to take care, that clone00.bin (saved as "clone00.bin" with STARTER on PC or via setting P0804 = 00 with the OP) is available on the MMC, used for an automatic parameter download at start-up. Otherwise automatic download will not be processed.

Successful automatic download

After a successful automatic download, F0395 will be displayed.

- In case of a standard CU a confirmation is necessary.
- In the case of CUs with safety integrated functions, an acceptance test must be performed.

Confirmation

On standard CUs the current parameter set needs to be checked and confirmed by clearing F0395. It can be cleared via:

- Digital input or PLC signal (depends on the settings of P0700)
- setting P7844 = 0.



Warning

The user is responsible for ensuring that the parameters held in the CU are the correct parameters for their application.

Acceptance test

On CUs with integrated fail-safe functions it is necessary to do an acceptance test (refer to the "Safety-Integrated functions" section in this manual). To clear F0395 on CUs with integrated fail-safe functions the following procedure has to be followed:

- P0010 = 30
- P9761 = fail-safe password
- P7844 = 0

Automatic download fault

If the automatic download process fails, the CU will return to the parameter set previously held in the EEPROM and the following fault codes are generated:

Table 3-1 Automatic download fault codes

Fault code	Description
F0061	Automatic download of parameters was not successful.
F0063	Automatic download of parameters was not successful (e.g. wrong CU).

In this case check, whether the MMC is defective or a parameter set clone00.bin is available or the parameter set is valid.

3.2.2 Swap Behavior of the Inverter

Swap behavior of the inverter

The SINAMICS G120 inverter comprises of Power Modules (PM) and Control Units (CU)

Both, PM and CU, can be replaced e.g. to change a defective component. The exchange of either a PM or a CU is called a "swap".

The following swaps are possible:

- PM hotswap with powered CU (CU is powered via external 24 V source)
- CU swap
- PM swap, including a CU power cycle

Note

A standard CU will not accept a parameter set from a CU with fail-safe functions and vice versa.

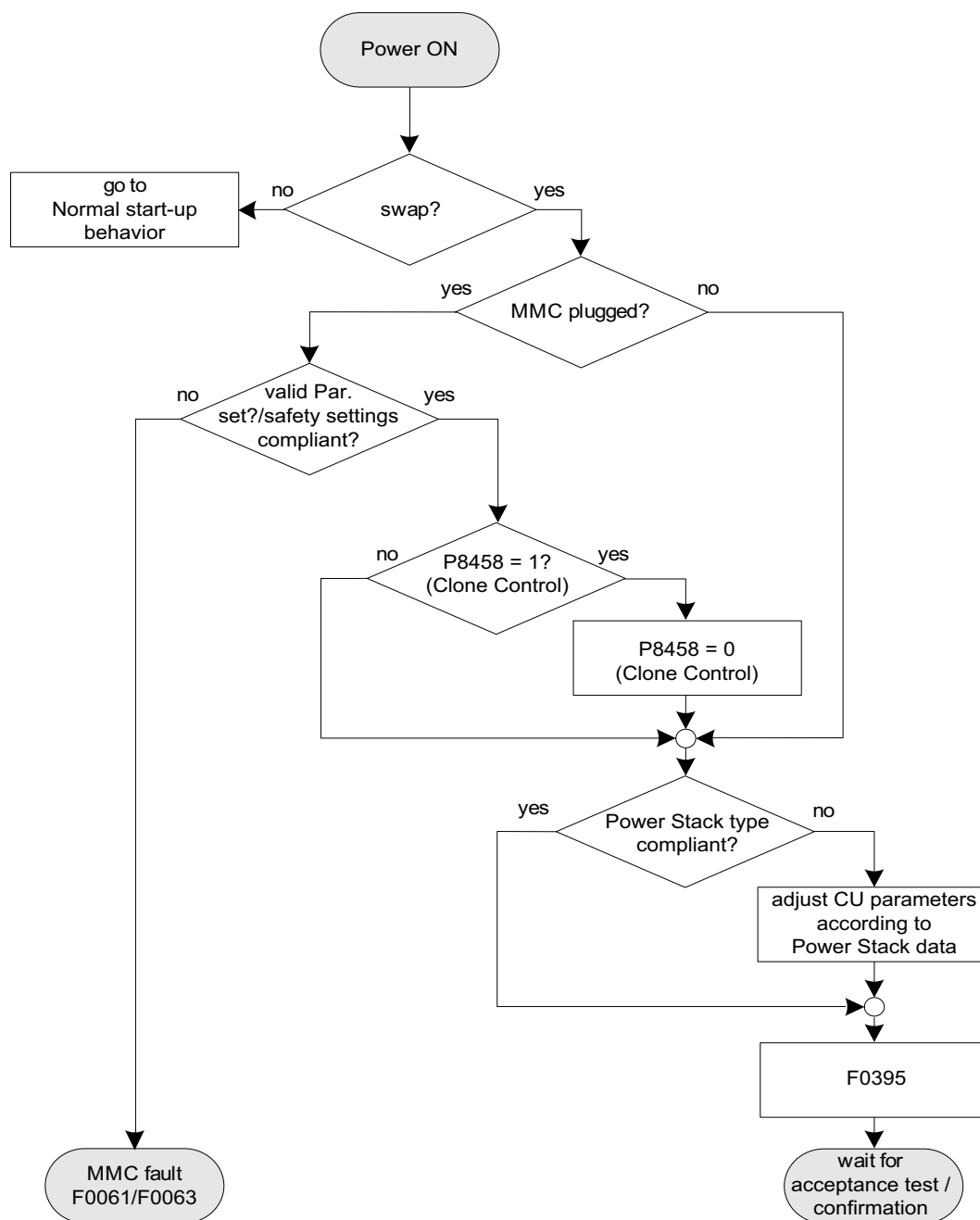


Figure 3-2 Swap behavior of the inverter

PM hotswap with powered CU



Caution

Before performing a hotswap, make sure that all parameters are stored in the EEPROM of the Control Unit (see P0014 or P0971).

In this case the power module can be hot swapped without power cycling the CU. A parameter set either from MMC or from CU EEPROM is loaded into the CU RAM to prevent faults.

A successful swap is indicated by F0395, a swap fault by F0061 or F0063. See description below.

CU swap

A CU swap always results in a power cycle of the CU. This causes a demand for loading a parameter set either from MMC or from CU EEPROM into the CU RAM. If an MMC with a valid parameter set is plugged, the CU loads the parameter set from the MMC, if no MMC is plugged, the parameter set from the CU EEPROM is loaded.

A successful swap is indicated by F0395, a swap fault by F0061 or F0063. See description below.



Caution

Before snap-on the Control Unit to the Power Module while hot swap connect 24 V supply to the terminals.



Warning

When carrying out a CU swap it is not allowed to replace a CU with fail-safe functions with a CU without fail-safe functions. Replacing a CU with fail-safe functions with a CU without fail-safe functions disables all potentially implemented fail-safe functions and therefore can lead to personal injury and damage to the machine.

A replacement of CU with fail-safe functions with a CU without fail-safe functions has to be assumed as completely new application.

PM swap, including a power cycle

Same behavior as CU swap

Successful swap

After a successful swap, F0395 will be displayed.

- In case of a standard CU a confirmation is necessary.
- In the case of CUs with safety integrated functions, an acceptance test must be performed.

Confirmation

On standard CUs the current parameter set needs to be checked and confirmed by clearing F0395. It can be cleared via:

- Digital input or PLC signal (depends on the settings of P0700)
- setting P7844 = 0.



Warning

The user is responsible for ensuring that the parameters held in the CU are the correct parameters for their application.

Acceptance test

On CUs with integrated fail-safe functions it is necessary to do an acceptance test (refer to the "Safety-Integrated functions" section in this manual). To clear F0395 on CUs with integrated fail-safe functions the following procedure has to be followed:

- P0010 = 95
- P9761 = fail-safe password
- P7844 = 0

Swap fault

A swap fault is indicated if the automatic download fails. In this case, the CU will return to the parameter set previously held in the EEPROM and the following fault codes are generated:

Table 3-2 Automatic download fault codes

Fault code	Description
F0061	Automatic download of parameters was not successful.
F0063	Automatic download of parameters was not successful (e.g. wrong CU).

In this case check, whether the MMC is defective or a parameter set clone00.bin is available or the parameter set is valid.

3.3 Upload and download of parameter sets

Upload of parameter sets

With an upload, a parameter set can be saved in one of the following devices:

- PC (via STARTER)
- MMC
- OP

An upload can be triggered via

- PROFIBUS,
- OP
- STARTER

A detailed description is given in "Series Commissioning" in the commissioning section.

Download of parameter sets

In the case of a parameter download it is important to distinguish between the following possibilities:

- Manual download
- Automatic download.



Caution

Parameter download between different types of control units and of different firmware versions is not recommended.

Basically, it is possible to download parameter sets off different CU types, however, as the parameter sets might differ, the user is fully responsible for the consistency of the downloaded parameter set.

Therefore, the customer has to confirm his responsibility in case of an automatic download by acknowledging F0395.

Manual download

A manual download can be performed similar to an upload via

- PC (STARTER)
- MMC
- OP

It can be triggered - like upload - via

- PROFIBUS,
- OP
- STARTER

With a manual download a parameter set without the safety related parameters is downloaded from one of the above mentioned devices into the inverter.

A detailed description is given in "Series Commissioning" in the commissioning section.

Automatic download

An automatic download needs a MMC to be performed. It is not possible to perform an automatic download from a PC or from the OP.

The automatic download starts according to the settings in P8458 after power cycle or a after a swap (see "Start-up behavior" in this section).

Contrary to a manual download even the safety parameters are downloaded with an automatic download.

Note

Manual and automatic download

With a manual download all necessary parameters excluding the safety parameters (only with fail-safe CUs) are downloaded into the inverter. A detailed description is given in "Series Commissioning" in the commissioning section.

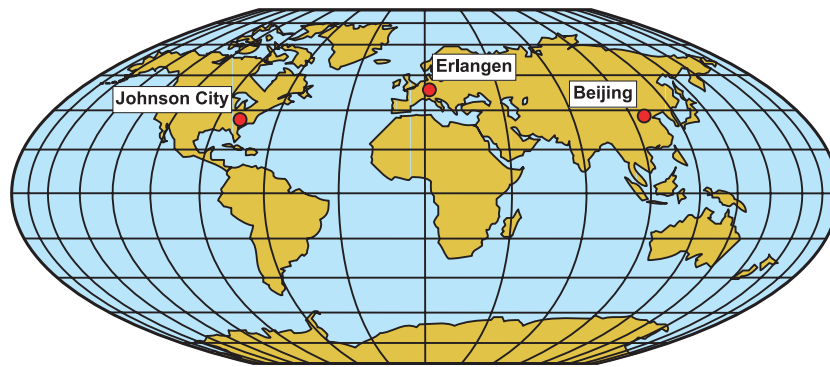
With an automatic download even the safety parameters are downloaded into the inverter. An automatic download can only be performed with an MMC at Start-up or after a swapping an inverter component (CU or PM). A detailed description is given in "Start-up behavior" of this section.

Service and maintenance

4.1 Service and support information

A&D Technical support

24-hour technical support is provided by three main centres worldwide.



A&D Global service and support

Europe/Africa (Erlangen)

Tel: +49 (180) 5050 222

Fax: +49 (180) 5050 223

Email: adsupport@siemens.com

America (Johnson City)

Tel: +1 (423) 262 2552

Fax: +1 (423) 262 2589

Email: simatic.hotline@sea.siemens.com

Asia/Pacific (Beijing)

Tel: +86 (1064) 757 575

Fax: +86 (1064) 747 474

Email: adsupport.asia@siemens.com

China (Beijing)

Tel: +86 (1064) 71 9990

Fax: +86 (1064) 71 9991

Email: adscs.china@siemens.com

Online Service and support

Comprehensive information and support tools are available from the Service and Support internet site at:

<http://support.automation.siemens.com>

Contact address

Should any questions or problems arise while reading this manual, please contact Siemens at the following address:

Siemens AG
Automation & Drives
A&D SD SPA PM4
Postfact 3269
D-91050 Erlangen
Germany

Email: documentation.sd@siemens.com

Regional contacts

For questions regarding services, prices and conditions of technical support, please contact your local Siemens partner.

4.2 Faults and Alarms

Faults

In the event of a failure, the inverter switches off and the red LED "SF" will be on. The fault code will be displayed via OP, STARTER or Communication interface (if fitted, resp. connected).

Note

To reset the fault code, one of three methods listed below can be used:

1. Cycle the power to the inverter.
 2. Press the **Fn** button on the OP
 3. Use digital input 2 (default setting).
-

Fault messages are stored in parameter r0947 under their code number (e.g. F0003 = 3). The associated error value is found in parameter r0949. The value 0 is entered if a fault has no error value. It is possible to read out the point in time that a fault occurred (r0948) and the number of fault messages (P0952) stored in parameter r0947.

A detailed description of the fault messages is provided in the Parameter List.

The fault state indication by LED is shown in the following sections.

Alarm messages

The alarm code will be displayed via OP, STARTER or Communication interface (if fitted, resp. connected). Alarm messages are stored in parameter r2110 under their code number (e.g. A0503 = 503) and can be read out from there. A detailed description of the alarm messages is provided in the Parameter List.

4.3 LED Overview

Status display via LED

The SINAMICS G120 inverters provide multiple functions and operating states which are indicated via LED.

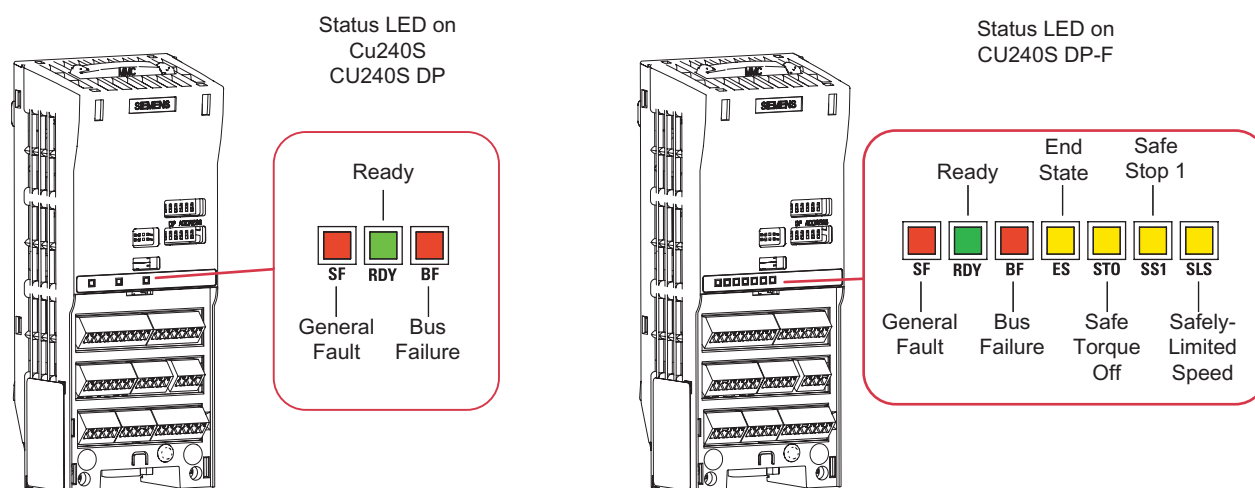


Figure 4-1 State LED on the CU240S, CU240S DP, CU240S DP-F

Colours

The colours of the LEDs are self explanatory. The Status of the inverter is displayed by the following different LED colors and states:

Meaning	Color	State		
		on	off	Temporary state (flashing 0.5 Hz)
Fault indication LED • SF • BF	Red			
Ready LED • RDY	Green			
Fail-safe LED • ES • STO, SS1, SLS	Yellow			

If for a certain state it is indifferent whether the LED is ON, OFF or flashing it is mentioned as "not relevant".

LED description

- System-Fault LED (SF)

The system-fault LED indicates a general system error either software or hardware related.

- Ready LED (RDY)

The ready LED indicates whether the inverter is ready to operate by transmitting a control-word.

This LED does not indicate whether the drive is running or not. For that purpose an OP would be more convenient. The information of interest is the actual speed, which can be displayed on an OP which can be easily plugged in and out at any time during operation.

- Bus-Failure LED (BF)

The Bus-failure LED indicates if any bus failure occurred. A bus failure can be characterised as corrupted communication (e.g. a frame of the PROFIBUS) due to signalling problems on the bus itself.

Note that faults according to the inner data structure of the transmitted communication frames (e.g. CRC check of PROFIsafe telegram) are not denoted as bus failure. Thus, such failures have to be indicated by the general fault LED.

The Bus-failure LED indicates the following states:

- Bus-failure LED off: no Bus failure
- Bus-failure LED on: no connection to the DP-Master (searching for baud rate)
- Bus-failure LED flashing 0.5 Hz: I/O device is not configured or is wrongly configured (baud rate found, no data exchange).

- End-state LED (ES)

The end-state LED indicates if the end state of a triggered fail-safe function has been reached

- Safe Torque Off LED (STO)

The safe torque off LED indicates the fail-safe function Safe Torque Off.

- Safe Stop 1 LED (SS1)

The safe stop 1 LED indicates the fail-safe function Safe Stop 1.

- Safely-Limited Speed LED (SLS)

The safely-limited speed LED indicates the fail-safe function Safely-Limited Speed.

For fail-safe functions please refer to section Function.

4.4 Normal Status LEDs

Normal Status LEDs

Table 4-1 Status display

LED			Description
SF	RDY	BF	
red	green	red	
		not relevant	Ready or running, connection to bus master ok
			Ready or running, no connection to the bus master
		not relevant	Commissioning
		not relevant	General fault
not relevant	not relevant		Bus failure (search baud rate)
not relevant	not relevant		Bus failure (no data)
			No supply available

4.5 Fail-Safe Function Status LEDs

STO Fail-safe function states via LED

LED							Description
SF	RDY	BF	ES	STO	SS1	SLS	
red	green	red	yellow				
not relevant	not relevant	not relevant			not relevant	not relevant	STO parameterized
not relevant	not relevant	not relevant			not relevant	not relevant	STO triggered
not relevant	not relevant	not relevant			not relevant	not relevant	STO reached
not relevant	not relevant	not relevant					LSTO triggered

SS1 Fail-safe function states via LED

LED							Description
SF	RDY	BF	ES	STO	SS1	SLS	
red	green	red	yellow				
not relevant	not relevant	not relevant					SS1 parameterized
not relevant	not relevant	not relevant		not relevant		not relevant	SS1 triggered
not relevant	not relevant	not relevant		not relevant		not relevant	SS1 reached
not relevant	not relevant	not relevant				not relevant	STO reached, end state for SS1

SLS Fail-safe function states via LED

LED							Description
SF	RDY	BF	ES	STO	SS1	SLS	
red	green	red	yellow				
not relevant	not relevant	not relevant					SLS parameterized
not relevant	not relevant	not relevant		not relevant	not relevant		SLS triggered
not relevant	not relevant	not relevant		not relevant	not relevant		SLS reached

4.6 Further indication for LEDs

Further states, displays via LED

LED							Description
SF	RDY	BF	ES	STO	SS1	SLS	
red	green	red	yellow				
		not relevant					Safety commissioning
		not relevant					Firmware update from MMC
		not relevant					Parameter download from MMC

4.7 Troubleshooting with the OP

Troubleshooting with the OP

If the motor fails to start when the ON command has been given:

- Check that P0010 = 0.
- Check the inverter state via r0052
- Check command and setpoint source (P0700 and P1000)

Warnings and faults are displayed on the OP with Axxx and Fxxx respectively. The individual messages are shown in the Parameter List.

Note

Motor data must relate to the inverter data power range and voltage.

Troubleshooting/FAQs

Status display via LED

The SINAMICS G120 inverters provide multiple functions and operating states which are indicated via LED.

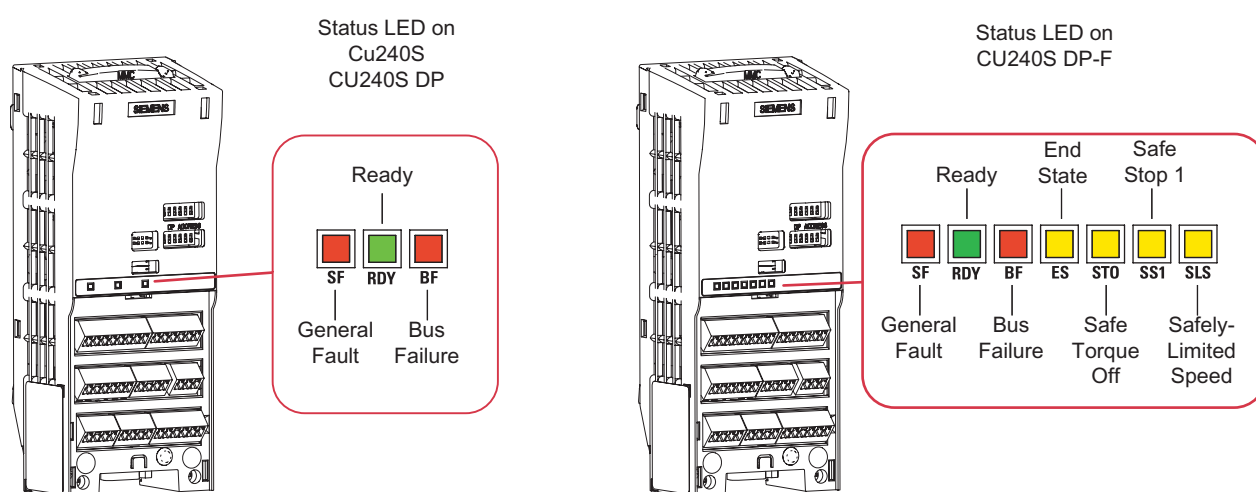


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The colours of the LEDs are self explanatory. The Status of the inverter is displayed by the following different LED colors and states:

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The safe torque off LED indicates the fail-safe function Safe Torque Off.

- Safe Stop 1 LED (SS1)

The safe stop 1 LED indicates the fail-safe function Safe Stop 1.

- Safely-Limited Speed LED (SLS)

The safely-limited speed LED indicates the fail-safe function Safely-Limited Speed.

For fail-safe functions please refer to section Function.

Overview

There are three types of diagnostic display:

- LED – see previous section.
- Alarm Numbers
- Diagnostic parameters.

Diagnostics using alarm numbers

If a Basic Operator Panel (BOP) is fitted to the Control Unit and a alarm or fault condition occurs, the BOP will display the appropriate alarm or fault number.

If an alarm occurs, the alarm number will be displayed and the inverter will continue to run, although it is possible that it may run in an unexpected manner depending upon the alarm condition.

If a fault occurs, the fault number will be displayed and normally the inverter will be stopped.

Table 5-1 Alarm numbers, cause and remedy

Alarm Number	Meaning	
A0700	Cause	The parameter or configuring settings by the PROFIBUS master are invalid.
	Remedy	Correct the PROFIBUS configuration
A0702	Cause	The link to the PROFIBUS is interrupted.
	Remedy	Check connector, cable and PROFIBUS master.
A0703	Cause	No setpoints or invalid setpoints (control word = 0) are being received from the PROFIBUS master.
	Remedy	Check setpoints from the PROFIBUS master. Switch SIMATIC CPU to "RUN".
A0704	Cause	At least one configured internode transmitter is not yet active, or has failed.
	Remedy	Activate internode transmitter.
A0705	Cause	No actual values received from inverter.
	Remedy	None (fault is with the inverter).
A0706	Cause	PROFIBUS-DP software error.
	Remedy	None diagnostic parameter r2041.
A0710	Cause	Inverter has detected failure of PROFIBUS communications link.
	Remedy	Communication interface on Control Unit may be broken.
A0711	Cause	Invalid value of PROFIBUS parameter.
	Remedy	Check P0918 address and P2041.
F0070	Cause	No communication via PROFIBUS. Triggered by A0702, A0703 and A0704. The telegram failure time set in P2040 has run out. Details see section "Faults and Alarms" in the Parameter List.
	Remedy	Check connection of the communication devices and ensure that a valid control word is being used.

Identification of the communications components

The read-only parameter r2053 shows the information by which the various firmware components of the PROFIBUS-DP interface can be identified.

Table 5-2 Identification of communications firmware

Parameter	Meaning
r2053.00	0: Inverter cannot identify the communications interface
	1: PROFIBUS DP detected
	2: No assigned
	56: Undefined communications error
r2053.01	Firmware version
r2053.02	Constant "0"
r2053.03	Firmware date (year)
r2053.04	Firmware date (day and month)

Standard diagnostics

When the parameter P2041.03 = 0, then by using the read-only parameter r2054 and it's indices, it is possible to obtain detailed diagnostic information regarding the PROFIBUS-DP interface. This information is listed in table below.

Table 5-3 Standard diagnostics

Parameter	Meaning
r2054.00	PROFIBUS-DP status:
	0: Off
	1: Baud rate search
	2: Baud rate found
	3: Cyclical data exchange
	(> 100: other diagnostic screen active)
r2054.02	Number of acyclical links with class 2 master (PC, OP): 0 ... 2
r2054.03	Error number of last unsuccessful parameter access operation through an acyclical link.
r2054.04	Parameter number of last unsuccessful parameter access operation
r2054.05	Sub-index of last unsuccessful parameter access operation

When parameter accessing errors occur, r2054.03 display the appropriate error number, these are listed in table below.

Table 5-4 Parameter accessing error numbers

Number	Cause	Remedy
0 ... 199:	Parameter access has been converted to a PKW request. Error detected in the inverter. Additional information is in r2054.05 and r2054.06: Parameter number, index word	
0	Parameter number does not exist	Check data block number
1	Parameter number cannot be modified	--
2	Minimum/maximum not reached or exceeded	--
3	Sub-index does not exist	Check data block offset
4	Access of single value with array identifier	Set data block offset = 0
5	Access to word with double word request or vice versa	Use correct data type (e.g. INT for word, DINT for double word)
6	Setting not allowed (resetting only)	--
7	Descriptive element cannot be modified	--
11	No status as master control	--
12	Key word missing	--
17	Request cannot be processed due to operating state	--
101	Parameter number currently deactivated	--
102	Channel not wide enough	--
104	Illegal parameter value	--
106	Request not implemented	--
200/201	Modified minimum or maximum not reached or exceeded.	Minimum or maximum can be further limited in operation
240 ... 249:	Parameter access is incorrectly formatted. Error detected on the PROFIBUS DP. Additional information in r2054.05 and r2054.06: Parameter number or S7 data block number, sub-index or S7 data block offset.	
240	Error in variable address (no additional information)	Legal: "Data block" area
241	Data block number illegally formatted	Legal: 1 ... 31999
242	Data block offset illegally formatted	Legal: 0 ... 116
243	Illegal "type"	Legal: CHAR, BITE, INT, WORD, INT, DWORD, REAL
244	Illegal "Number of elements" on accessing parameter value	Legal: Effectively 2 or 4 bytes
248	Illegal text/description modification	--
249	Inconsistency in write request: "Type" and "Number of elements" does not match "Data type" and "Data length"	Error in communication device
250:	Parameter access has been converted to a PKW request. Response from inverter is seen as incorrect. Error detected on the PROFIBUS-DP. Additional information can be seen in r2054.05 and r2054.06.	
250	PKW response does not match request	Error in the inverter
251:	Error detected on the PROFIBUS-DP; no additional information	
251	Response too long for response telegram	Error in communication device

Troubleshooting with the OP

If the motor fails to start when the ON command has been given:

- Check that P0010 = 0.
- Check the inverter state via r0052
- Check command and setpoint source (P0700 and P1000)

Warnings and faults are displayed on the OP with Axxx and Fxxx respectively. The individual messages are shown in the Parameter List.

Note

Motor data must relate to the inverter data power range and voltage.

Index

A

Alarm messages, 4-3

C

Calculating the motor/control data, 2-24
Changing parameters with the Operator Panel, 2-13
Commissioning, 2-54
Commissioning the application, 2-30
Control Wiring, 1-4

D

Download parameters, 2-43

E

Encoder Interface
Connections, 1-10
Preparation, 1-10

F

Factory setting, 2-9
Reset to, 2-53
Fault messages, 4-3
Fitting the Control Unit to the Power Module, 1-2

M

MMC
Manual download, 2-48
Upload, 2-47, 3-3
Monitoring parameters, 2-3
Motor data identification, 2-26
Motor data identification routine, 2-29

N

Normal Status LEDs, 4-6

O

OP, 2-43

P

Parameter
upload, 3-9
Parameters
Access level, 2-5
Active, 2-7
Attributes, 2-3
BICO, 2-4
Change state, 2-5
Data sets, 2-8
Data types, 2-5
Grouping, 2-6
Quick commissioning, 2-8
Unit, 2-6
Value range, 2-8
Power Modules
Fitting the Control Unit to the, 1-2

R

Reset to the factory setting, 2-53

S

STARTER
Download, 2-46
Upload, 2-45
Status display, 4-4, 5-1

T

Troubleshooting
with the OP, 4-9, 5-6
TTL Encoder, 2-55
Typical encoder wiring, 1-10

U

Upload parameter, 3-9

Upload parameters, 2-43

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